SCIENTIFIC AMERICAN SUPPLEMENT No. 521

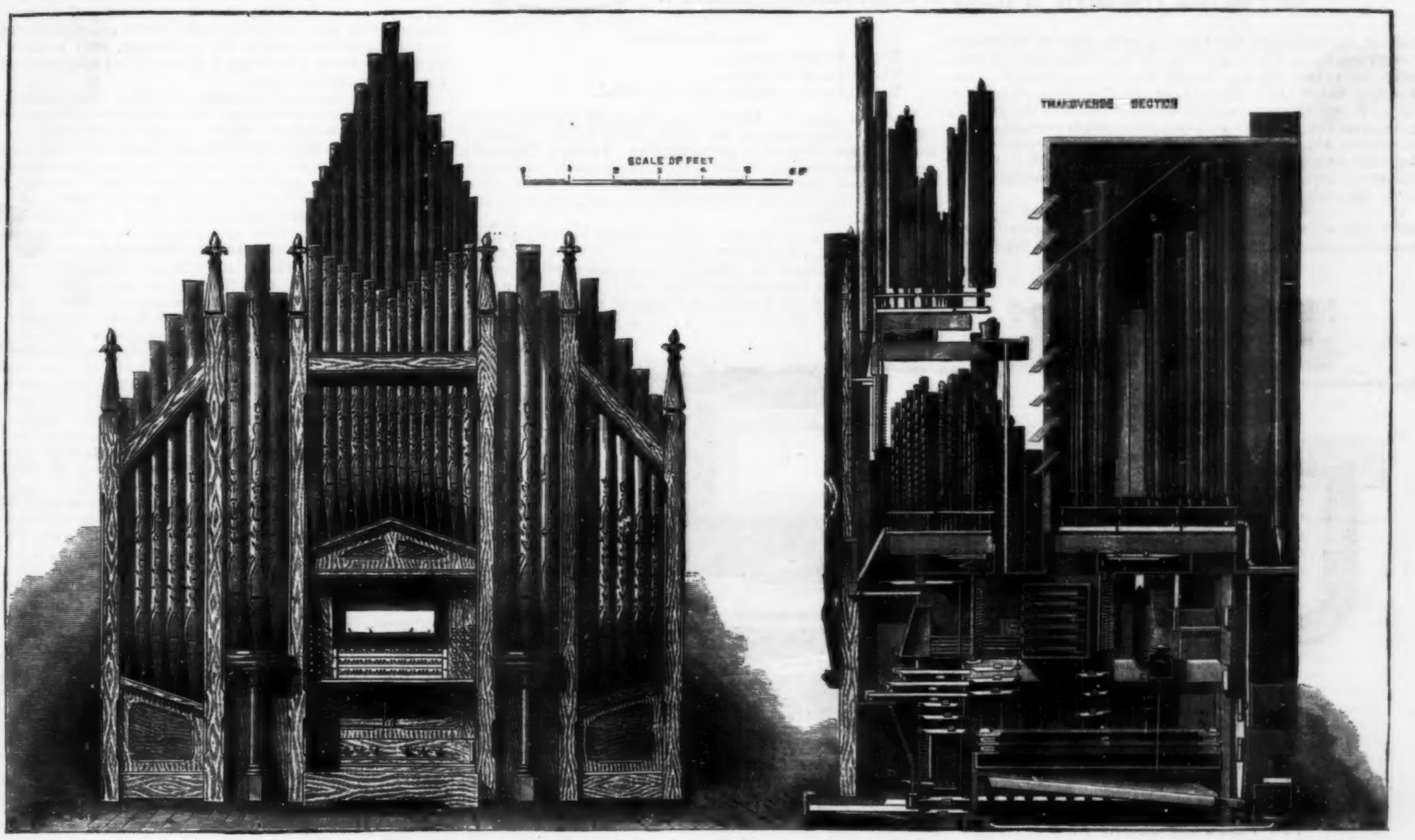
Scientific American Supplement, Vol. XX., No. 521.
Scientific American, established 1846.

NEW YORK, DECEMBER 26, 1885.

Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.

WEDLAKE'S IMPROVED ORGAN.

We have been requested by several of our readers to give a description of the most noteworthy features of the numerous organs exhibited during the recent International Inventions Exhibition; and although we cannot do all in this direction that appears to our correspondents desirable, we have selected two organs which seem to be specially worthy of attention for illustration and description. The instruments in question have been constructed by Mr. Wedlake, of Berkley road, Regent's Park, and by Messrs. Mitchell and Thyne. The latter stood in the music room; the former—which we illustrate and describe this week—is a much smaller instrument, stood in an out of the way corner at the end of the long music gallery, and its proportions were dwarfed by the splendid organ exhibited by Messrs. Walker. Mr. Wedlake's organ, however, contains much that is extremely interesting, not only to the organist, but to every lover of mechanism; and it is perhaps hardly too much to say that Mr. Wedlake has succeeded in doing a nearly impossible thing, to wit, he has invented a new valve.



WEDLAKE'S IMPROVEMENT IN ORGANS.

In order to make what follows intelligible, we must premise that in all our modern organs of any pretensions to excellence, what are known as pneumatic levers are fitted to reduce the labor of playing. When a key is pressed down by the organist's finger, a little "pallet," or flap valve, is pulled open, against a pressure of air tending to keep it shut. When couplers are used, the organist, in putting down one key with his finger, pulls down one or more other keys, with which the first is for the time coupled, and the resistance is proportionately augmented. The labor of playing was well known to the last generation of organists. The pneumatic lever serves the purpose of what electricians call a "relay." The organist opens a very small valve, which admits air under pressure to a little bellows, one of the boards of which, being movable, is connected with the pallet before referred to. Thus it will be understood that the little bellows, of pneumatic lever, does all the heavy work, and the keys of a huge organ offer no more resistance to the player's fingers than the keys of a piano do.

This great gain has not been obtained without some loss. So long as an organist opened a pallet direct by the muscular effort of his fingers, he was in touch, so to speak, with his instrument; and although it is practically impossible for the best organist to get anything equivalent to the marvelous effect of touch manifested in pianoforte playing, yet it was possible to put forth *some* expression, but the pneumatic lever killed all that. With it a pallet is open or shut—there is no medium—and the organist does not know whether it is open or shut save by hearing. He cannot feel. Now, Mr. Wedlake's improvements in organs have resulted in restoring the connection between the organ and the instrument, while retaining all the advantages of the pneumatic lever. On this point we reproduce information supplied to us by Dr. C. W. Pearce, Fellow and Member of the Council of the College of Organists, who, writing to us on the subject, says: "Situated in one of the most out of the way, unnoticeable nooks in the Exhibition, at the end of the long Central Gallery, is an organ which for beauty of tone and perfection of mechanism will compare most favorably with the other organs in the building, even with instruments of double its size. One only needs to sit down and play upon it for five minutes to discover the real artistic pleasure it is capable of giving the performer. A sensation of real grip, such as no other pneumatic action has ever given, at once establishes a sympathetic bond of union between artist and mechanism—*direct contact*, in fact, with the sound-producing apparatus—as direct as that which has hitherto been almost exclusively enjoyed by pianists and violinists. Moreover, the action is perfectly noiseless, there being not the least suspicion even of a click or a thud to disturb the musical rhythm. This is especially the case in rapid repetitions of a single note, such as are to be met with in Mr. W. T. Best's arrangement of Mozart's 'Zauberflote' overture, an arrangement which organists well know is perfectly impracticable on an organ with the ordinary pneumatic action, but which can be played with facility upon this instrument."

This is valuable testimony from a high musical authority. He puts this in other words in a testimonial which he has given to Mr. Wedlake: "After," he says, "giving three recitals on the organ in the Inventions Exhibition, built by Mr. Henry Wedlake, I have much pleasure in stating that the new patent pneumatic action applied to that instrument leaves little to be desired as far as touch is concerned. My previous experience of pneumatic action may be thus summarized: I have found it costly, complex, noisy, and unsympathetic. All sensation of grip was entirely removed, and an unseen medium seemed interposed between the player and his instrument, which, to a large extent, nullified that feeling of direct contact with the sound-producing apparatus which is as dear to the organist as to the violinist or pianist. I have no hesitation in saying that Mr. Wedlake has given the organist a touch which is as sympathetic as it is noiseless; and which being produced by simple means is therefore inexpensive. His pneumatic touch enables the performer to realize that he is playing upon the very organ itself, and not upon a dumb keyboard, which, however quickly and effectively it acts upon the organ mechanism, nevertheless does its duty in such a cold-blooded manner as to reduce his enthusiasm to its minimum." We have now to see how the end in question is attained.

In the pneumatic levers hitherto in use, wind under a pressure of 5 in. or 6 in. of water is admitted from the air receivers of the organ into the collapsed bellows, and distends it. In the Wedlake pneumatic system, the arrangements are reversed. The bellows are placed in a box, or chest, kept full of wind under pressure. The valve being open, the wind is thus in the bellows as well as surrounding it. On raising the valve to the flexible seat, the compressed air now in the bellows is allowed to escape, and, the pressure being only external, the bellows collapses, and opens the sound-board valve. Thus, the same pressure of wind that closes the bellows opens it again on the valve dropping from the flexible seat and closing the exhaust aperture. By this system one-third more power is gained, from the fact that the wind is pressing on the ribs, or yielding portion of bellows, at the time when there is most suction on the sound-board valve; whereas, in the original method, the wind does not take effect on the ribs until the bellows are partially opened, the suction having been overcome and the pallet opened.

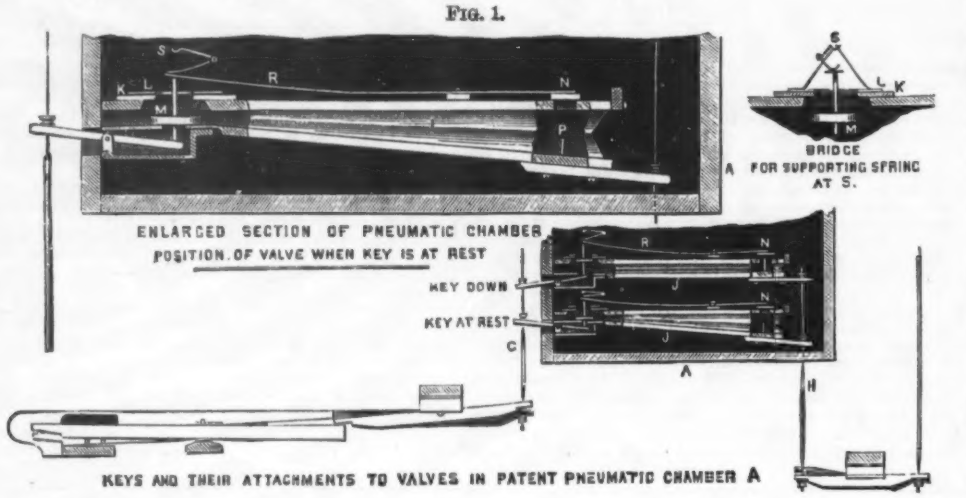
We give a front view and a transverse section through the organ, which is a three-manual instrument, CC to G, fifty-six notes, and pedal organ, CCC to F, thirty notes, and contains the following stops, couplers, etc. It will be noticed by organists that there is no "mixture" stop in the entire organ, and those who have not heard the instrument may be inclined to regard the omission of these harmonic stops as a serious defect; but the general brightness of tone fully compensates for what would ordinarily be considered a loss of brilliancy in the full organ *ensemble*.

In the section of the organ, A shows the new patent pneumatic levers located in a chest filled with wind of the same pressure as that supplied by the "feeders," or bellows, below. B is the pedal "sound-board," that is, the perforated board on which the pedal pipes stand at the back of the organ; C is a tremulant to the swell organ, D are the light-touch valves of this organ, E and F are the same for the great and choir organ, H is the connection from the pneumatic levers to the swell organ, backfalls, and octave couplers, Above, we give sections of the pneumatic chambers and bellows. The bellows is now open, and the pallet, not shown, is closed. The organist presses down a key, and by so doing pulls down the tracker, G. This causes the valve, M, to rise from its lower seat and close the upper orifice. The result is that the air, no longer confined in the bellows, is squeezed out by the pressure in the pneumatic chamber—shown in solid black—the lower board is raised, and the wire fixed to it operates to open the pallet and cause the pipe or pipes proper to the particular key touched to speak.

The valve, M, and its seat is a very curious and ingenious arrangement of mechanism. The valve itself is a little disk of wood covered smoothly with leather; the seat, K is of soft leather glued all round the hole in the center to the top board of the little bellows; on top of K

lies a ring of cardboard, which serves, oddly enough, to support the leather seat. A pneumatic lever, such as we have illustrated, was shown in a glass box by Mr. Wedlake, and its action was well worth careful study. As the valve, M, was raised, the seat, K, was drawn down to meet it, the cardboard modifying the form of the curve taken by the leather. In the same way, when the valve was falling away, K followed it down for a certain distance, and then came away with a jerk, leaving a large opening available for filling the bellows, and so closing the pallet and silencing the note in a hurry. It is to this peculiar correspondence between the valve and its seat that the special touch of this organ, named by Dr. Pearce, is due. The valve can always be felt, so to speak, as it rests on its elastic seat. The valve, M, is kept in its place by a spring of thin

FIG. 1.

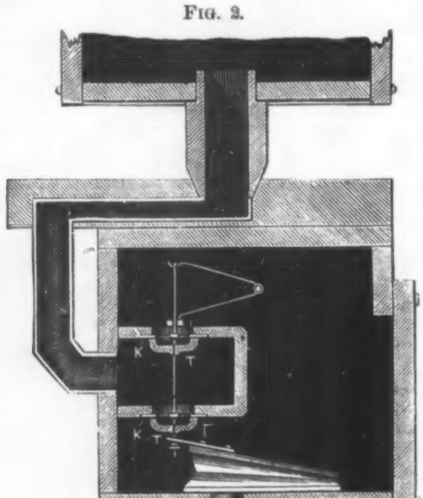


KEYS AND THEIR ATTACHMENTS TO VALVES IN PATENT PNEUMATIC CHAMBER A

wire, S, hooked into the top of a wire gallows or bridge shown in front view above. R is a long strip of thin cane, or other elastic wood, which prevents M from slipping sideways. The other end of this carries a valve, N, which, normally closed, is raised by the pin, P, as soon as the lower board has gone high enough, thus admitting air, and preventing the bottom board from clapping noisily against the top board, which it would otherwise be certain to do when a rapid passage was being played.

It will be seen that the space occupied vertically is extremely small; and for this reason all the pneumatic levers for a large organ can be stowed into a compara-

FIG. 2.



ENLARGED SECTION OF IMPROVED VALVE FOR PEDAL SOUNDBOARD AT B

tively shallow box—which is often a matter of great importance where height is lacking.

We append the specification of the organ:

Great Organ.

1.	Open diapason	metal	8 ft.	56 pipes.
2.	Stopped diapason and claribel	wood	8 ft.	56 "
3	Horn diapason	metal	8 ft.	56 "
4.	Principal	metal	4 ft.	56 "
5.	Harmonic flute	metal	4 ft.	56 "
6.	Fifteenth	metal	2 ft.	56 "
7.	Trumpet	metal	8 ft.	56 "
	Total			392 pipes.

Swell Organ.

8.	Double diapason	wood	16 ft. tone.	68 pipes.
9.	Open diapason	metal	8 ft.	68 "
10.	Rohr flute	wood	8 ft.	68 "
11.	Echo dulciana	metal	8 ft.	68 "
12.	Voix celeste	metal	8 ft.	68 "
13.	Principal	metal	4 ft.	68 "
14.	Fifteenth	metal	2 ft.	68 "
15.	Cornopean	metal	8 ft.	68 "
16.	Oboe	metal	8 ft.	68 "
	Total			612 pipes.

Choir Organ.

17.	Dulciana	metal	8 ft.	56 pipes.
18.	Lieblich gedackt	wood	8 ft.	56 "
19.	Suabe flute	wood	4 ft.	56 "
20.	Piccolo	metal	2 ft.	56 "
21.	Clarionet	metal	8 ft.	56 "
	Total			280 pipes.

Pedal Organ.

22.	Open bass	wood	16 ft.	30 pipes.
23.	Sub-bass	wood	16 ft. tone.	30 "
	Total			60 pipes.

Couplers.

24. Swell to great.
25. Octave swell.
26. Sub-octave swell.
27. Swell to choir.
28. Swell to pedal.
29. Great to pedal treble side.
30. Bass side.
31. Choir to pedal.
32. Octave pedal.

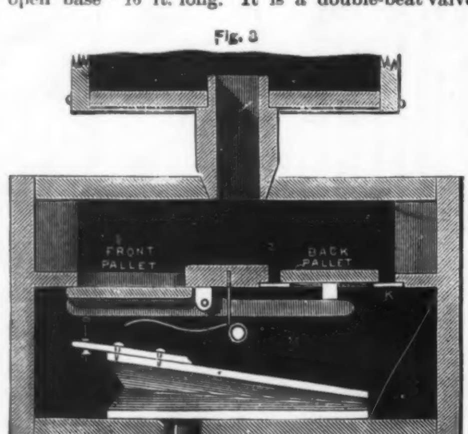
Composition Pedals.

Three to great organ.
Three to swell organ.
Tremulant to swell organ by pedal.

We feel that in describing this most ingenious mechanical arrangement we have quite failed to convey an adequate idea of its peculiarities. Indeed, these can only be realized by those who have seen it in action, and noticed the wonderful sensitiveness of the flexible seat, and the manner in which it is apparently attracted toward the valve.

So far we have spoken of the valves in the pneumatic levers alone, but there are other valves in an organ. The pedal organ is fitted with tubular pneumatics. Referring to the section, they will see at B a section of one used for the great pedal pipe above it, an "open base" 16 ft. long. It is a double-beat valve,

Fig. 3



ENLARGED SECTION OF IMPROVED VALVE FOR PEDAL SOUNDBOARD AT B

T T, and therefore balanced. Enlarged sections are given above. The pedal when put down permits air to escape from the little bellows, which then pulls down the valve or pallet. Then air escapes from the trunk, and flows round to the foot of the pipe, as shown clearly enough in cross section. Now, it is no news to engineers that double beat valves are not always quite tight, because it is not easy to seat two rigid valves rigidly connected on two rigid seats rigidly connected; and difficult as this may be in engine work, it is still more difficult in organ work, which is necessarily much less accurate. Mr. Wedlake solves the whole difficulty by making one of his valve seats, K', elastic, and we believe that the same thing might be done with very considerable advantage with steam valves. It will exercise the ingenuity of some of our readers, perhaps, to find how this can be effected. Mr. Wedlake secures elasticity by making the aperture controlled by one of the valves larger than the valve, and securing leather round its edges. Thus, when the valve is opened, the disks are drawn away from their seats. That which has a rigid seat at once opens, but the seat follows the other valve a certain distance, and aids the valve to open still further; and, when the valve is being closed, one meets its elastic seat before the other meets its rigid seat, and shock is entirely prevented. A modification of the same valve is also shown in Fig. 3, which explains itself. There are several other points about the organ which deserve notice, but for which we have not space. Mr. Wedlake also exhibited a most ingenious arrangement for fitting organ pedals to pianos, about which we shall have more to say at another time.

In conclusion, we may add that Dr. C. W. Pearce speaks in the highest terms of this instrument from a musical point of view, that is to say, as regards quality and brilliancy of tone.—*The Engineer.*

INSECT WHITE WAX.

THE following details are from a report by Mr. Hosie of a journey through Central Ssu-ch'uan, in June and July, 1884, undertaken chiefly for the purpose of collecting information on the subject of insect white wax, as well as specimens of the insect wax trees and forms of the wax product, at the desire of the Director of Kew Gardens.

The subject of insect white wax may be briefly discussed under the following heads:

1. The insect tree. 2. The insects. 3. The wax tree. 4. The wax.

1. *The Insect Tree.*—This tree is known to the Chinese in the extreme west of Ssu-ch'uan as the "ch'ung shu" (insect tree) and the "tung ch'ing shu" (wintergreen or evergreen tree), while in the east of the province it is generally called the "pao ke-tsao" (crackling flea tree), owing, as Mr. Baber has explained, to the sputtering of the wood when burned. It is probably the *Ligustrum lucidum* (?) of the botanist; but the specimens I am forwarding to Kew Gardens will decide this point. Although it is found scattered about the whole of Ssu-ch'uan, its chief habitat is the Valley of Ning-yuan Fu or Chien-ch'ang, in the west of the province. It is an evergreen, with leaves which spring in pairs from the branches. They are thick, dark green, glossy, ovate, and pointed. In the end of May or beginning of June the tree bears clusters of small white flowers, which give place to small seeds of a dark blue color.

2. *The Insects.*—In the month of March, 1883, I passed through the Chien-ch'ang Valley; but, knowing that Mr. Baber had already reported on the subject of white wax, I confined myself to a mere cursory examination of the insect tree. In that month, however, I found, attached to the bark of the boughs and twigs, numerous brown pea-shaped excrescences or galls in various stages of development. In the earlier stages they looked like minute univalves clinging to the bark. The larger galls were readily detachable, and, when opened, presented either a whity-brown pulpy mass or a crowd of minute animals, whose movements were only just perceptible to the naked eye.

During the present year, in the months of May and June respectively, I had the opportunity of examining these galls and their contents with some minuteness in the neighborhood of Ch'ung-k'ing, and within the jurisdiction of Chia-ting Fu, the chief wax-producing country in the province.

In the former case I should state that the insects have reached Ch'ung-k'ing and its neighborhood from Chia-ting by short annual stages, being propagated on the insect tree in the country lying between these two cities; 30 li to the east of Ch'ung-k'ing I plucked the galls from the trees, and on opening them—they are very brittle—I found a swarm of brown creatures, like minute lice, each with six legs and a pair of club antennæ, crawling about. The great majority of the galls also contained either a small white bag or cocoon, containing a chrysalis, whose movements again were visible through the thin covering, or a small black beetle. This beetle also has six legs, and is likewise provided with a long proboscis armed with a pair of pincers. It is called by the Chinese, in Chia-ting, the "niu-erh," or "buffalo," probably from its ungainly appearance. I carried several of the small white cocoons home with me, and found that within a few days each chrysalis developed into a black beetle or "buffalo." If left undisturbed in the broken gall, the "buffalo" will, heedless of the wax insects which begin to crawl outside and inside the gall, continue to burrow with his proboscis and pincers in the inner lining of the gall, which is apparently his food. The Chinese declare that the beetle eats his minute companions in the gall, or, at least, injures them by the pressure of his comparatively heavy body; and it is a fact that the galls from Chien-ch'ang, in which the beetles are numerous, are sold cheaper than those in which they are absent. A careful examination, however, has forced me to the conclusion that the beetle is there for a far more useful purpose.

When a gall is plucked from the insect tree, an orifice is disclosed where it was attached to the bark. By this orifice the wax insects escape. If, then, the galls remain attached to the bark, how can the wax insects escape from their imprisonment? I carried back with me a bough with a number of intact galls clinging to it, and watched day by day for signs of life. At last my patience was rewarded by seeing the pincers of the beetle gradually boring a hole through the gall. This hole, when completed, was circular, and of sufficient size to allow him to escape from his imprisonment. Although he did not issue when he had broken his prison wall, but continued to burrow in the inner lining, the wax insects began to crawl out and in, and I am persuaded that the beetle is a wise provision of nature to afford an outlet for the wax insects. That the beetle devours the insects may well be doubted, for I endeavored, but without success, to feed him with the daintiest morsels; he always turned away, and recommenced burrowing. When I removed the beetles from the galls, some of them made efforts to fly; but at that time their elytræ were not sufficiently developed, and they had to content themselves with crawling, a movement which, owing to the long proboscis, they performed very clumsily.

There is another insect, called the "la-kou," or "wax dog," which plays a part in the production of white wax; but, as this creature develops on the wax tree, I will refer to it under the head of "Wax."

At Chia-ting I examined galls that had been brought from the Chien-ch'ang Valley. They were suspended on the wax trees, and were for the most part empty; but in the very first I opened I found a solitary "buffalo." The insects had all escaped to the branches through the natural orifice.

The Chien-ch'ang Valley is the great insect-producing country; but, given a number of galls and the insect tree, the insects may be propagated elsewhere, as in Chien-wei Hsien, in the south of Chia-ting Fu, and even in the neighborhood of Ch'ung-k'ing. These latter insects are, however, declared to be inferior, and fetch a lower price.

Mr. Baber has graphically described the annual headlong flight of the insect carriers across the mountains from Chien-ch'ang to Chia-ting; but I should mention that their flight is not confined to the night. In 1882, I met insect carriers hurrying in the heat of the day, through Kuei-chou to the Province of Hunan; but, owing to the greater length of the journey, it is

just possible that they were traveling both night and day. The galls I saw in Kuei-chou were packed loose in trays in long bamboo baskets, through which a current of air could freely pass. In Chien-ch'ang, on the other hand, the galls are made in paper packets, each weighing about 12 Chinese ounces, and a load usually contained sixty odd packets. At their resting places the carriers open up and spread out the packets in cool places, in order that the heat may not force the insects to escape from the galls during the journey. As it is, a packet on arrival in Chia-ting is usually an ounce lighter than in Chien-ch'ang. In years of plenty a packet of insects laid down in Chia-ting costs about half a tael; but this year only about a thousand loads are said to have reached Chia-ting from Chien-ch'ang, and about thirty loads from Chien-wei. The consequence is that the price has risen to a tael a packet for Chien-ch'ang insects. Chien-wei insects are inferior and cheaper.

In good years a packet of Chien-ch'ang insects will produce from three to four catties of wax, the present price of which is about 40 taels a picul. In bad years not more than a catty may be expected, so that altogether the trade has a considerable element of risk in it.

In Chia-ting, the insects are divided into two classes, called respectively the "la-sha," or "wax-sand," and the "huang-sha," or "yellow" or "brown sand." The former, which are of a reddish-white color, are declared to be the wax producers, while the latter, which are of a brownish color, are said to produce no wax.

3. *The Wax Tree.*—This tree, which is known to the Chinese as the "pai-la-shu," or "white wax tree," is cultivated extensively within the Prefecture of Chia-ting, more especially within the districts of O-mei, Lo-shan, and Chien-wei. It is, I am told, also grown in the north of the province, but nowhere else have I seen or heard of it. It is usually a stump varying from three and four to a dozen feet—the average height may be taken as six feet—with numerous sprouts or branches rising from the guarled top of the stem. The leaves spring in pairs from the branches. They are light green, ovate, pointed, serrated, and deciduous. The branches are rarely found more than six feet in length, as those on which the wax is produced are cut from the stems with the wax. The sprouts of one or two years' growth are too pliant, and it is only in the third year, when they are again sufficiently strong to resist the wind, that wax insects are placed on them. In June some of the trees were bearing bunches apparently of seeds in small pods, and the specimens I am forwarding to the Director of Kew Gardens will probably suffice to identify the tree.

4. *The Wax.*—The wax insects, which reach the wax tree districts from Chien-ch'ang and Chien-wei about the beginning of May, are made into small packets of twenty or thirty galls, which are inclosed in a leaf of the wood oil tree, whose edges are fastened together with rice straw. These small packets are then suspended close to the branches under which they hang. A few rough holes are made in the leaf by means of a large needle, so that the insects may find their way through them to the branches.

On emerging from the galls the insects creep rapidly up the branches to the leaves, where they remain for thirteen days, until their mouths and limbs are strong. During this period they are said to moult, casting off "a hairy garment," which has grown in this short time. They then descend to the tender branches, on the under sides of which they fix themselves to the bark by their mouths. Gradually the upper surfaces of the branches are also dotted with the insects. From the spots where they fix themselves they are said not to move, and I have watched them thickly studded on the bark, apparently motionless. The day after removing a branch, however, I have seen them rushing about wildly, and it may be that they derived their nourishment from the bark, but, unfortunately, I have no microscope sufficiently powerful to discover the nature of their food or the method of excreting the wax. The Chinese idea is that they live on dew, and that the wax perspires from the bodies of the insects! Be this as it may, the specimens of the branches incrusted with the wax show that the insects construct a series of galleries stretching from the bark to the outer surface of the wax.

But I must here introduce the "la-kou," or "wax dog," which is developed in the early stage of wax production. I was unable to obtain a specimen of this insect; but it was described to me as a caterpillar, in size and appearance like a brown bean. I have a theory, which, however, is unsupported by outside evidence. It may be assumed that there are both sexes of the beetle, or "buffalo." On emerging from the gall the beetle is at first unable to fly, or at least unable to fly far, and both sexes doubtless remain for a time among the branches of the wax tree or of the insect tree, as the case may be. My theory is that the female deposits eggs on the boughs, and that the "wax dog" is the offspring of the "buffalo." I will not go further; but there may be some connection between this caterpillar and the gall containing the wax insects.

It is said that during the night and early morning the insects relax their hold of the bark, and that during the heat of the day they again take firm hold of it. About noon, I saw the owners of the trees moving from tree to tree, armed with thick clubs, wherewith they belabored the stumps, in order to shake off the "wax dog," which, they assert, destroys the wax insects. After the first month or so, however, when the branches are coated with the wax, the "wax dog" is unable to reach the insects, and the trees are no longer belabored.

Wind and rain are greatly dreaded when the insects are first suspended on the trees, for the tiny creatures are liable to be blown away or drowned.

Mr. Baber has well likened the first appearance of the wax on the boughs and twigs to a coating of sulphate of quinine. This gradually becomes thicker, until after a period of from ninety to a hundred days the wax, in good years, has attained a thickness of about a quarter of an inch. This refers to the Chien-ch'ang insects, for the wax of the Chien-wei insects is ready in from sixty to seventy days, and is less thick.

I have said that white wax is produced in the neighborhood of Ch'ung-k'ing; but, as the wax tree does not grow so far east, the galls containing the insects are taken from one insect tree and placed on other insect trees. This production is inferior in quantity and quality.

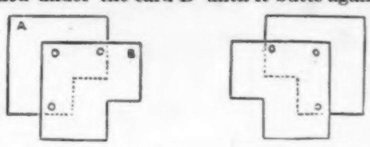
When the wax is ready the branches are lopped off, and as much of the wax as possible is removed by hand. This is placed in an iron pot with water, and the wax, rising to the surface at melting point, is skimmed off and placed in round moulds, whence it emerges as the white wax of commerce. The wax which cannot be removed by hand is placed with the twigs in a pot with water, and the same process is gone through. This wax, as might be expected, is less white, and of an inferior quality. Not satisfied, however, that all the wax has been collected, the operator takes the insects, which have meantime sunk to the bottom of the pot, and, placing them in a bag, squeezes them until they have given up the last drop of their special product. They are then—an ignominious ending to their short and industrious career—thrown to the pigs!

When I was in Chia-ting in June, the market price of white wax was 40 taels a picul; but owing to the anticipated decrease in the production of the present year, a rise was soon expected.

White wax is used chiefly in the manufacture of candles. Mr. Baber has pointed out that this wax melts at 160° F., whereas tallow melts at about 95°. In Ch'ung-k'ing an allowance of 3½ mace of white wax is melted up with each catty of tallow to give the latter greater consistency, and the candles of this mixture are dipped in melted white wax, which gives them a harder sheathing and prevents the tallow from running over when they are lighted.

MOUNTING PHOTOGRAPHS.

AN appliance calculated to be useful, especially to amateurs, when mounting photographs upon cards to show a definite margin, was brought forward by Mr. H. S. Starnes at the last meeting of the London and Provincial Photographic Association. Two pieces of card, A and B, are fixed by three tacks upon a drawing board, in the position shown. The corner of the mount is pushed under the card B until it butts against the



edges—shown by dotted lines—of the card A. The print is then laid down with its corner fitting the angle cut in B, and thus any number can be mounted upon the cards without the necessity for measuring and marking each mount. It was suggested by a member that if two corner-fittings (as shown in our sketch) were used instead of one, the direction of the print upon the mount would be truer; and that if the photographs themselves were not cut exactly of one length, it would be seen, and could be allowed for, keeping the same amount of margin at each end. The top or bottom of the mount should be placed in this double fitting, rather than one of the sides, as a little difference in the height of a print upon the card is permissible, but it must be central as regards the sides.—*Photo. News.*

THE PRINCIPLES INVOLVED IN THE CONSTRUCTION OF SPRAY-TUBES.*

By ANDREW H. SMITH, M.D.

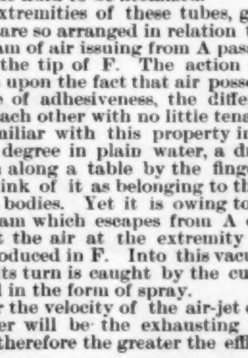
THE Bergsen or, as it is more commonly called in this country, the Sass spray-tube, having practically superseded all other forms, it is to this that attention will be confined in this paper.

The instrument consists essentially of two tubes placed one above the other, the upper one, which for brevity's sake we will designate A, carrying compressed air or steam, while the lower one, which we will call F, supplies the fluid to be atomized.

The free extremities of these tubes, greatly diminished in size, are so arranged in relation to each other that the stream of air issuing from A passes at a right angle across the tip of F. The action of the spray-tube depends upon the fact that air possesses a considerable degree of adhesiveness, the different particles adhering to each other with no little tenacity.

We are familiar with this property in viscid fluids and to a less degree in plain water, a drop of which can be drawn along a table by the finger, but we are not apt to think of it as belonging to the atmosphere or to gaseous bodies. Yet it is owing to the fact that the air or steam which escapes from A clings to and drags with it the air at the extremity of F that a vacuum is produced in F. Into this vacuum the fluid rises, and in its turn is caught by the current from A and dispersed in the form of spray.

The greater the velocity of the air-jet escaping from A, the greater will be the exhausting force exerted upon F, and therefore the greater the efficiency of the



atomizer. As the velocity of the stream of air is greatest at its center, where it is least retarded by friction, it follows that the axis of the opening of A should be exactly on a line with the extremity of F.

The pressure being the same, the character of the spray will depend upon the relative size of the openings of A and F. Increasing the former permits more air to escape, and gives a larger volume of spray with a greater carrying force and more power of penetration. Increasing the latter results in a larger consumption of fluid, forming a coarser spray, and, if carried too far, results in dripping.

A large opening for A with a small one for F gives a large body of very fine spray. A small opening for A with a large one for F gives a small body of coarse spray. A successful application of spray to the throat or to the posterior nares often requires that it be effected as it were by surprise, and before there is time for reflex action of the muscles. Hence it is necessary that spray should be formed the instant the air-valve is opened; for, if the arrival of the liquid at the point of F is delayed appreciably after air begins to issue from A, reflex contraction will have been excited by the contact of the air with the mucous surface before any spray is produced. Now, no fluid will reach the point of F until all the air in F is exhausted, and the amount of air and the length of time required for its exhaustion will be in proportion to the length and the caliber of the tube. Hence these should be reduced to a minimum in spray-tubes intended for making quick applications. And, as there is nothing lost in any case by this construction, it may as well be made the general rule for all tubes.

With a properly constructed spray-tube, comparatively slight air-pressure will suffice for all purposes. Increase of pressure will compensate in a measure for defective construction of tubes, but it brings with it its own inconveniences, such as mechanical irritation of the surface to which the spray is applied, waste of compressing power, etc.

The indications for the use of coarse or fine spray do not come within the scope of this paper, and will vary in accordance with the views of individual practitioners.

* Read before the American Laryngological Association, June 25, 1885.

LAMP FOR HEAVY OILS.

M. HELOUIS has submitted to the Societe d'Encouragement a system of lighting by means of liquid hydrocarbons hitherto regarded as too heavy for use as luminants. It is commonly understood that, to obtain a good lighting effect from a hydrocarbon flame, burning freely in air, it is necessary that there should be a certain ratio between the carbon and hydrogen of the combustible, and also between the combustible and the oxygen of the air required to burn it; and, further, that the mixture of combustibles and supporters of combustion should take place under a sufficient pressure. To obtain a white light from the combustion of heavy oils, it is necessary to bring to the naturally red and smoky flame of these fluids a quantity of air, not merely of sufficient volume, but also conveniently distributed among the hydrocarbon particles when the latter are brought to a state of extreme division. The pulverization of the heavy oil by the air would be sufficient; but a permanent lighter would be required, such as a gas-flame or the flame of a lamp, placed at the outlet of the pulverizer. Practical trials of such an arrangement have shown that the flame of the heavy oil goes out when the pilot light is removed, and that, in any case, a certain proportion of the oil escapes ignition, and falls in fine rain around the apparatus. M. Helouis has now dispensed with the pilot light, by previously heating the pulverized jet. For this purpose the lamp is placed over a little cup to contain a few drops of mineral spirit, which is lighted when the lamp is started. The end of the pulverizer is covered with a series of truncated cones, which become red hot from the flame, and keep the heavy oil in a fit state for regular combustion. An extracting injector, giving a kilogramme of steam per hour, will work four pulverizers. The light is said to be very white, and equal to about 320 candle power from a pulverizer consuming about 2¼ lb. of heavy oil, costing 1d. per hour.

CHEMICAL PROCESS FOR RAMIE.

A CHEMICAL process by M. Reynaud, of St. Denis (Reunion), consists in the employment of a solution obtained by lixiviating ashes of wood, or even of the woody part of the ramie, and therefore it is a cheap process, since this woody part, besides serving for heating purposes, leaves an ash which is utilized in the process. The ash, after being treated with so much hot water to give a cold solution showing 1·025° to 1·030° specific gravity, is immersed either in the natural state or, better, slightly broken up by means of a wooden roller. After some time, varying according to the maturity of the fiber, it is taken from the bath, and the ramie is immersed in cold water; then each stem is taken separately in the left hand, and worked on and back between the index and thumb of the right hand, when by this simple pressure the skin and a large quantity of the gummy substance can be removed. The fibers are thus obtained divided to a large extent, and are found floating about in water. It is only necessary to take them by the right hand, and to separate the fiber without any effort whatever from the wood. The separated fibers are now brought back into the original ash lye, and left there for a few minutes, then well washed in running water, and finally dried in the stove or in the open air. It is easy to ascertain when the stems have been long enough in the bath by taking one out and trying it; when the skin is easily removed, then they can be taken out. The same bath can be used several times.

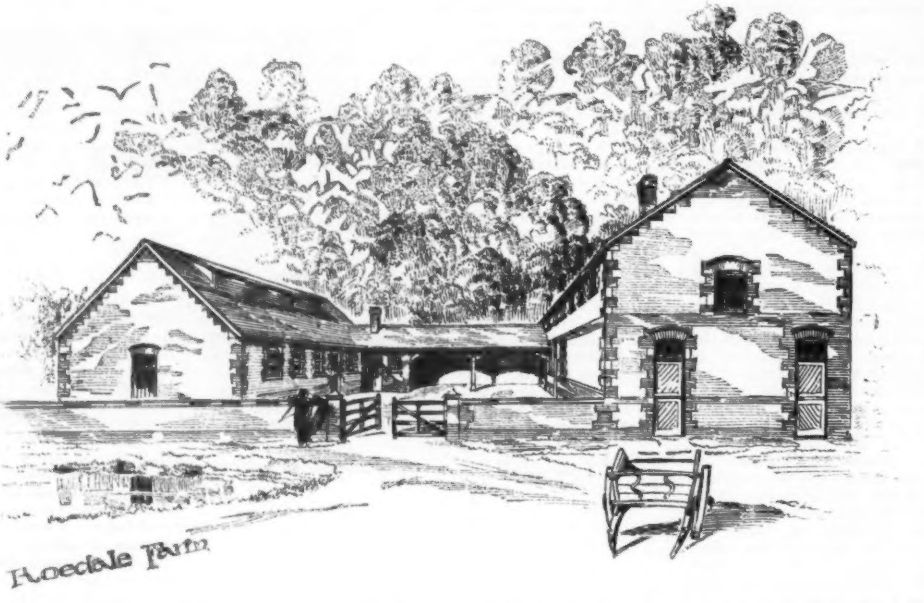
ARTIFICIAL LITHOGRAPHIC STONES.

The *Patent Blatt* describes a process introduced by M. Rosenthal, of Frankfort, for making artificial lithographic stones. The ingredients consist simply of cement. In the first place, a sufficient quantity of finely ground cement is mixed with water and allowed to harden into slabs, either in the open air or in an oven. When the cement has set, these slabs are wetted and heated until they crack in all directions; it is then reduced to a fine powder, and is well mixed with an equal quantity of fresh cement. This mixture is put, in a dry state, into strong cast iron moulds, and is subjected in them to a pressure of from 35 to 30 atmospheres. A sufficient quantity of water is then introduced on one side of the mould, and is drawn through the mass of dry powder by means of a pump connected with the opposite side; this water contains a certain quantity of extremely finely powdered cement, which is thus caused to penetrate through the mass, expelling at the same time the air and cementing it firmly together. The artificial stone is subjected to further pressure. In this manner slabs of the required size can be formed economically. Carbonate of lime may be substituted for cement, in which case the stones are of a lighter color.

FARM BUILDINGS.

THE buildings shown in our illustrations have been erected within the last few months upon farms belonging to Lady Ogle, of Withdeane Court, Sussex, Eng. At Tongdeane Farm the new buildings, in addition to the cottages shown in the view, comprise cart sheds, root houses, stock yard and a cowhouse for sixty cows, with all the latest improvements in the drainage and water supply, each cow having a separate water tap, and the water being obtained from the corporation reservoirs at Brighton.

The buildings at Tongdeane and Varndeane were erected by Mr. James Barnes, of Brighton, and the whole of the works were designed by Lady Ogle's architects, Messrs. Charles E. Clayton and Ernest Black, of Brighton.—*The Builder.*



THE PRESENT CONDITION OF THE YELLOWSTONE NATIONAL PARK.

By E. D. COPE.

TIME has fully justified the enterprise of Dr. Hayden in urging upon Congress the project of the creation of the Yellowstone National Park; and the protection of this and other especially interesting parts of our country by the arm of the National Government has met with almost unanimous approval.

The function of the Yellowstone Park may be looked on as three-fold: first, as a place of permanent preservation of the geysers and hot springs and their deposits; second, as a place of protection of the game of the country; and third, as a place of recreation for tourists. The first of these uses has always been uppermost. The second has been more and more engaging the attention of Congress, and the *Naturalist* published an editorial in its issue of July, 1884, pressing on public attention the necessity of making it a more complete preserve for game than it had previously been. This article was reprinted; and later, our contemporary *Science* took up the subject editorially. As a probable consequence of this agitation, a bill was introduced into Congress, last winter, providing for a more complete supervision of the territory of the park. Ten men with a gamekeeper and the superintendent constitute the present force. As this was manifestly insufficient to police a territory of such great extent, the new bill contemplated the addition of fifteen men to the number, thus increasing the police to twenty-five men. Their salaries were fixed by the new bill at $1,500 per annum. The sum now paid is $900, from which the men are expected to feed themselves, an important consideration in so expensive a region. This bill was not passed.

Since the attention of Congress and of the press has been directed to the park, the protection of its beauties and curiosities has been more efficient. A number of persons have been fined for breaking the geyser deposits, including at least one member of Congress. In this respect the protection may be considered to be now fairly good. Protection of game has been less successful because more difficult, and because of the great inadequacy of the force. Bison, elk, moose, deer, etc., are far less abundant than when the park was first created. The bison have been, I am informed, reduced to a herd of about sixty individuals, and the elk have been decimated. The moose are confined to a small region. From the inaccessible nature of their habitat, mountain sheep have not been so reduced in numbers. Protection has, however, become more definite in this direction. During the past year several persons have been fined from $75 to $100, and one old hunter, who defied the guards, was caught, fined $100, and imprisoned for six months.

These measures of protection can, however, only be carried into effect by an increase in the force and their proper distribution throughout the territory. Persons may now hunt undetected in the park, and may drive game outside of its boundaries without difficulty and kill it. The disposition to kill is not controlled by any considerations of decency in some men. Thus a party of English shooters killed, for their amusement, twenty or thirty from the bison herd without taking any part of the animals for their use, thus reducing their numbers by one-fourth at least, at one battue. Some persons state that protection is useless because the game leaves the park in winter. This I ascertained is not true, for there are numerous well-protected localities where the game winter safely.

The bill which was brought before Congress last winter for the more efficient protection of the park should be passed by the Congress of 1885–86, with some possible amendments. Thus the force should be increased to twenty-five men, each with a salary of $1,000 per annum exclusive of his food and boarding. The park should be divided into twenty-five parts, each one supervised by one of the guards, with perhaps an assistant or roustabout. A simple house for the guard should be erected in each one of the divisions, and the guard should reside there through both winter and summer, and not be permitted, as is now the case, to come into the settlements and remain there during the winter. It is well known that large game may be more readily destroyed in winter than in summer. Those guards whose districts include the geysers will naturally be more occupied with the protection of these objects than with the protection of the game, as the one is generally abundant inversely to the other. Visitors should not be permitted to carry guns or other hunting apparatus through the park, and should be required to deposit them with some designated person to be held during their stay in it.

A project for reducing the size of the park has already been introduced into Congress. This is in order to permit the construction of a railroad to the Clark's Fork mining camp, through the park via the Yellowstone, the East Fork, and Soda Butte creek. As the law creating the park forbids the passage of railroads through it, it is sought to alienate a tract of land from the park, of a triangular shape, of about forty miles in length and twelve to fifteen miles wide at the widest part. An examination of the map will show that the direct route from the Clark's Fork mines to the Northern Pacific Railroad is not more than *one-tenth* as long as the one proposed to pass through the park, so that it is difficult to guess at the motive which prompts the proposition in view. The project should be subjected to the most rigid examination, as any alienation of the territory of the park seems to be unnecessary. On the other hand, much greater security as a game preserve would be accomplished if the region on the southeast border of the park, which includes the Hoodoo Mountains, were annexed to it. It is the headquarters of the game of the country, and that of the park frequently resorts to it. It is excessively rugged, and is nearly useless to man for any other purpose.

As regards the entertainment of tourists, the administration of the new superintendent, Mr. Weare, has been a great improvement over that of his predecessor. The monopoly of transportation sought to be established has been abolished, and competition is free to guides and hotel keepers. This naturally has the effect of reducing rates, and will do so still more, for the charges have not yet reached bed-rock. When this desirable result has been achieved, the Yellowstone National Park will become one of the most popular resorts for tourists of all nations, who will be amply repaid by an inspection of one of the few remaining regions of the earth where thermal activity still reaches its surface, and of the grand and impressive scenery which surrounds it.—*Amer. Naturalist.*

A NOVEL PAPER-CUTTER.

OUR Boulogne correspondent writes: "Some months since Holkar, while on a visit to Lord Dufferin, saw his lordship going through the process of cutting his newspapers and reviews. The Indian potentate asked for the ivory paper-knife, promising another in return. The prince returned recently to Government House, taking with him a young elephant. The animal had had its tusks shaped and sharpened, and between the rajah's two visits to Calcutta had undergone a training in secretarial work. When led into Lord Dufferin's presence, it took up some newspapers with its trunk, cut them, and placed them on a carpet in an orderly fashion."—*London Times.*

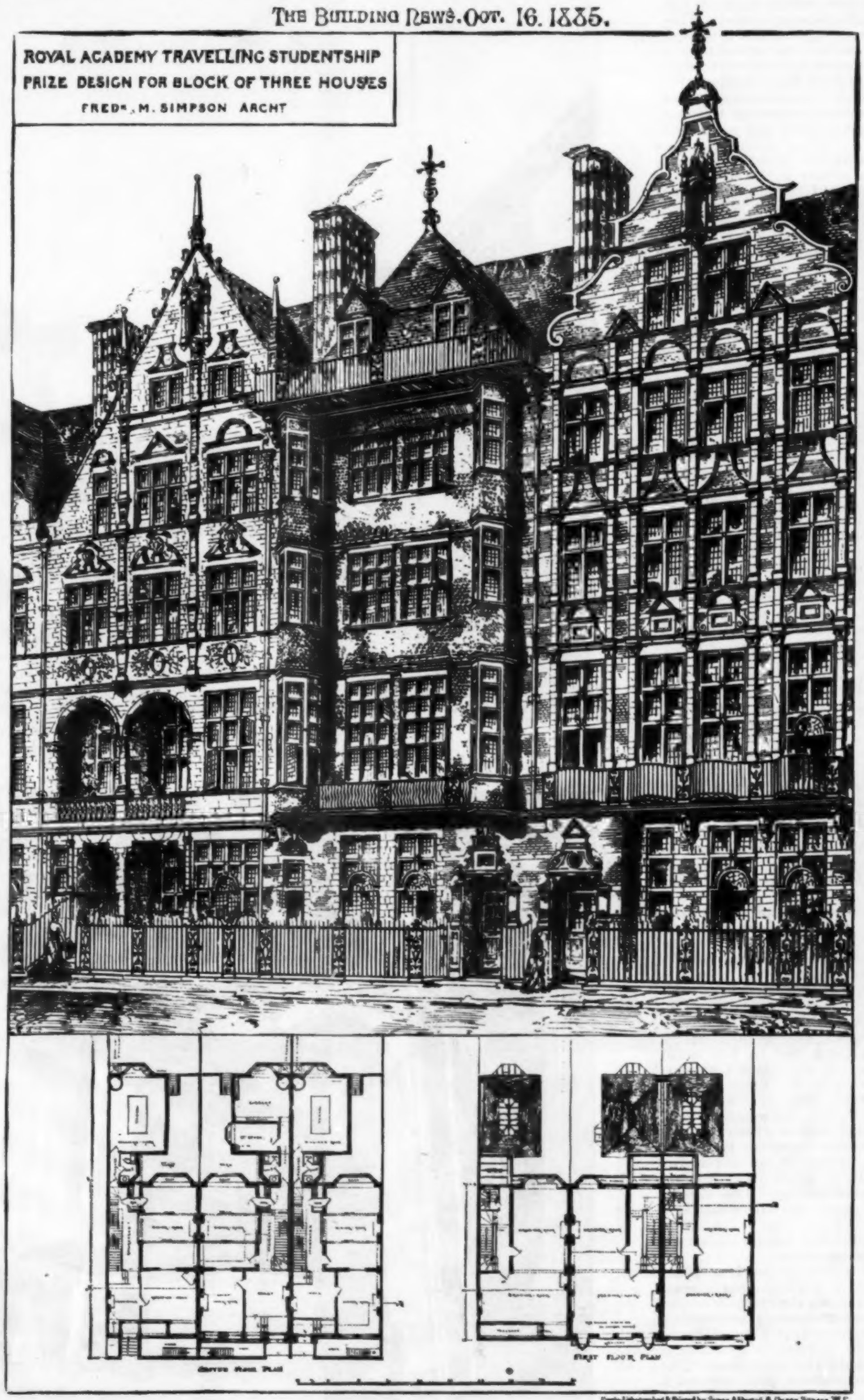
THE EFFECTS OF LIGHTNING STROKE.

AT a recent meeting of the Berlin "*Verein fur Innere Medicin*," Dr. Liman described the changes present in the bodies of two men who had been killed by lightning when taking shelter under the trees of the Thiergarten. In the one subject, the hair over the left temple was singed, and the skin from the left ear to the shoulder-blade was discolored a brownish-red, the chest and abdomen being covered with red and white streaks. Reference was made to the dendritic figures described in many cases, and attributed often to impressions of twigs, leaves, etc., and in this body there was a figure which could be compared to a palm-leaf, but which was undoubtedly due to the contact of the folds of the shirt. The parts thus pressed upon remained white, the surrounding skin being reddened. The apex of the heart was the seat of an irregular cavity, which communicated with both ventricles; evidently the lightning stroke had caused rupture of the organ. In the other case, the skin and hair were similarly excoriated and singed, and numerous ecchymoses occurred beneath the serous layers of the pericardium and pleura; the lungs were much congested. Here death was evidently due to asphyxia. Dr. Liman mentioned, and Professor Leyden confirmed, the fact that death by lightning is occasionally accompanied by rupture of internal organs, as the brain and liver.—*Lancet.*

FARM BUILDINGS, WITHDEANE ESTATE.

ROYAL ACADEMY TRAVELING STUDENTSHIP DESIGN FOR BLOCK OF THREE HOUSES.

THIS is a perspective drawing, exhibited in this year's Academy, of the design by Mr. Frederick M. Simpson, that gained the R.A. Traveling Studentship in 1884.—*Building News.*



NEW YORK LAUNDRIES.

ALTHOUGH thousands of small laundries exist, some managed by the robust daughters of the Emerald Isle, some by dusky maidens, and the rest by Celestials, the big laundries get the big bundles of soiled linen. Like everything else, washing and ironing have developed into a business of considerable size and importance. Says a writer in the *N. Y. Times*: The washerwoman nowadays has to compete with machinery and steam power. The washtub becomes a huge revolving drum, the wringing machine a centrifugal drier, the clothes line in the back yard a frame in a drying box, and the flat-iron an iron roller six feet in length. In buildings rising story upon story, an entire floor is devoted to each branch of the work. The bundles are gathered by covered wagons, and hundreds of women and girls are employed in the various branches. A day's stock of linen in a big hotel can be washed, dried, and ironed in six hours. Every week day is wash day in a big laundry, and in the middle of the summer season work is carried on during half of Sunday. In a big laundry on the West side of town, the manager's office is as comfortable and neatly furnished as that of a wholesale dry goods merchant. The manager is a man of business, having dealings with hotel proprietors and the agents of steamship and steamboat lines and palace car companies. The plant cost more than $100,000, and the concern is under the control of a stock company. It has facilities for turning out 75,000 pieces of linen in a day. In the busy season an ocean steamship will send 15,000 pieces to be done in a day. The company has built a tall, deep, well-lighted and well ventilated building of brick with stone trimmings. One 100 horse-power engine and two 200 horse power boilers furnish the power and the steam and hot water.

"A laundry is the poorest place in the world to show the use of money," the manager remarked in the course of a general talk about the business. "More than $100,000 in hard money has been spent in this laundry; but if I should take a business man through here and tell him what it cost, he would not believe me. The cost of the steam pipes that are out of sight in boxes was immense, and wood was not a small item. We must have the best of dried lumber for the drying boxes. Then come the washing machines and ironing machines. Of course, we are not working up to our limit all the time, but we must be ready for a rush any day in summer. We do the work of city hotels, ocean steamships, river and sound steamboats, and the Pullman Palace Car Company. Our biggest job lately was the linen of the sleeping cars that took to and brought from Washington the inauguration crowd. With trains going out every two hours, we had to be lively in order to furnish a stock of clean linen. Besides using our own wagons, we had to hire wagons to collect and deliver the bundles. We do a little piece work, but we don't cater to that trade. We have, perhaps, forty or fifty customers in this neighborhood, but the work for them does not amount to much. This is a separate branch of the business.

"Doing up new linen is another distinct branch of the business, and we do nothing with that. Some laundries do that and nothing more, and they have built up a fine business with furnishing houses. There are other big laundries that have only piece work. They get the collars, cuffs, and shirts supposed by many persons to be sent to Troy. The Troy laundry that you see on the signboards of furnishing and some dry goods stores is really in New York. Years ago, collars and cuffs were sent to Troy. Several large manufacturers of collars and cuffs are there; and when it used to cost seventy-five cents a dozen to have collars and cuffs washed and ironed here, they got the work because they could do it cheaper. But that work is done here now. The furnisher, while admitting that the work is done here, will tell you that it is the Troy finish that you will get. You will find the so-called Troy laundries wherever you go. I was down in Massachusetts a while ago, and saw a furnisher who advertised as the agent of a Troy laundry. I saw the card on one bundle, and it was that of a New York laundry. It is a big branch of the business, and can be carried on here just as well as in Troy. Machinery has cheapened the cost. Come into the wash room."

In the rear of the office, half the floor was given to the receiving and delivering of bundles, and the rest to washing machines. On the floor were piles of dirty linen, some comparatively clean and others offensively dirty. They were collected in big canvas bags marked with the name of the hotel or steamship. The linen is assorted and piled according to the degree of uncleanliness. The dirtest piles come from the kitchens. Each collection is washed, dried, and ironed separately, and each assortment is washed separately, a special washing machine taking the dirtiest. Along the sides of the room were big wooden iron-strapped drums reaching nearly to the ceiling, with lines of iron pipes on top and underneath. In the middle of the room were several smaller washing machines, and back of them were three centrifugal driers revolving at the rate of 800 times a minute. In the big drums are two revolving cylinders with arms that work in opposite directions. Soap is bought in casks by the hundred pounds, and when ready for use is melted and in a condition to be immediately taken up by the water. Through openings in the big drums pieces of linen are thrown as a farmer throws hay. One set of arms catches them and throws them about. When they fall, another set catches them and shakes them. About 150 sheets or 1,200 napkins and towels can be washed in each drum. For the dirtiest linen special soap and sal soda are used. The pieces tumble about, and the dirt falls out and is carried away through pipes. In the smaller washing machines the pieces are thrown into a cylinder of perforated iron that turns a few times one way and then reverses. The revolutions must be at a certain speed to insure thorough washing.

When washed, the pieces are packed in the upright centrifugal drying machines, from the sides to the axle. When the machines are in motion, the water flies out and the clothes gradually shrink away from the center and pack themselves solidly against the sides. The machines can run up to 1,600 revolutions a minute, but it is not considered necessary. The pieces are not thoroughly dried in the machines, but sufficiently so to be handled. They are sent up in elevators to the drying boxes. The floor of the wash room is as wet as the deck of a ship, and the planks have to be laid and calked like those of a ship. In the stories above are fifteen ironing machines, with rollers from five to six feet in length heated by steam and gas. In the drying boxes the heat is so great that pieces of linen are dried in eight minutes. The pieces are put on long frames that are run through the boxes, and by the time one end of a frame is reached the pieces on the other end are ready to be taken off.

"Concussion does the washing," the manager explained. "There must be some fall to clothes to knock the dirt out. It cannot be thrown out by centrifugal force, and it cannot be beaten out. The constant tumbling about is the only sure method. We have tried all kinds of washing machines, but we find those of our own make the best. We invented the ironing machines we use, and sheets that used to be ironed in the old fashioned way may now be ironed by machinery. In takes four girls to iron a sheet—two to put the corners between the rollers and two to take the sheet out. It is cheap labor, however, and is done by girls fourteen or fifteen years of age. Ironing is the longest part of the work, because each piece has to be handled separately. Collars, cuffs, and all plain pieces are ironed by machinery, but shirts are ironed by hand. There are some men who iron shirts, but most of them are graduates of State prison. It is easy enough to keep track of all the pieces by having a system. We give an entire floor to the work for the Pullman Company, and by making a separate job of each lot that comes in from a hotel or steamship we know where we stand. We charge so much a hundred pieces for a big lot, and every bundle that comes in this morning goes out to-morrow morning. In a rush we can take in a lot at 10 o'clock in the morning, and have it ready to send out at 4 o'clock in the afternoon. The pieces from an ocean steamship will vary from 300 to 15,000, and those from hotels run up to 2,500 a day. When travel is large the bundles are large, and they must be done in a hurry. Guests' linen is washed and ironed separately, like the rest of our piece work. Some hotels do the guests' washing, but the others send out the bundles with the house linen. For piece work each piece is numbered with indelible ink, and after going through the machines is put into a compartment corresponding in number to that piece. It is a good deal like sorting letters in a post office."

NATURAL GAS.

MR. S. SPECKLY, of Cool Hill, Venango Co., Pa., sends us an account of three wells on his farm, which are the largest ever found in Venango Co. They average a depth of 1,950 feet, and showed an open test pressure respectively of 70, 125, and 130 pounds per square inch. Gas from the first two wells is allowed to escape through an 18 foot length of 2 in. tubing, and shows inclosed pressures of 500 and 600 pounds. It is thought that the inclosed pressure in the third well would amount to 800 or 1,000 pounds, but the pressure was too great to permit the well to be packed. It supplies most of the gas consumed for domestic and manufacturing purposes in Oil City, Franklin, and Titusville.

A NINETY-EIGHT FOOT CRANE.

AFTER studying out and constructing a 42 foot crane for the Hotel des Postes, and a 49 foot one to be used in the work on the Church of the Sacred Heart at Montmartre, Mr. Bonnet, professor at the Central School, has solved a much more difficult problem in the erection of an apparatus capable of permitting 14 foot thick corners of pillar masonry to be laid as far as to the springing of the arches, and of the construction of vaults whose keystones are 88 feet above the floor of the nave.

The general view which we give in Fig. 1 will allow the general arrangement of the apparatus to be understood. The crane consists of a wooden frame, at the apex of which oscillates a balance which supports the pulleys over which pass the load and stay chains. This frame and its appurtenances rest upon axles provided with wheels, which allow the crane to be moved over a straight track laid in the nave upon a temporary platform three yards above the future floor of the nave. On account of the comparatively small circumference of the choir, however, it becomes necessary to use a shunting car to move the apparatus in this portion of the building.

The frame consists of two uprights, 72 feet in height above the rails and 13 inches square at the base, connected by cross pieces, and held by lateral traces and by inclined pieces in the rear. These pieces are properly braced, and united by bolts and tie bands. The wood used is pitch pine. The lower extremities of the uprights are fastened to the frame that supports the platform which carries the engine and windlasses. This frame, being obliged to withstand flexion, is of oak. It is through the intermedium of it that the crane rests upon the axles.

The balance at the top of the crane is 36 feet in length, and is so constructed as to offer great resistance with little weight. It consists of two parallel lattice girders provided with truss rods above, and firmly united with each other by cross pieces. The girders are 14 inches in width at the center and 10 at the extremities. In the center and at the extremities they have entire webs, and to these are riveted cast iron bosses that support, in the center, the axis of oscillation, and, at the extremities, bronze bearings in which revolve the axles of the guide pulleys for the load and stay chains. The bearings are provided with oil cups that contain sufficient lubricant to last several months. They can, moreover, be reached by means of rounds riveted to the upper angle irons of the balance. The center of gravity of the balance is above the axis of oscillation. Under these circumstances, before reaching a vertical position, it would come directly against the uprights of the crane. In order to prevent this, the center of gravity is brought beneath the axis of oscillation by a counterpoise fixed to the balance by means of angle irons and tie bars.

The motor that actuates the different parts of the apparatus is a vertical one of 5 H. P. It drives, through the intermedium of a belt, an auxiliary shaft that actuates the windlasses and the shifting apparatus.

The windlasses are of the Bernier type, with two velocities. The disengaging gear of the belts that actuate them is within reach of the engineman, near the motor. The load windlass is fixed between the two uprights, while the other is between the two rear braces.

For shifting the crane, motion is communicated to the driving axle by a train of gear wheels. This transmission is commanded by hand by means of a friction drum.

In the nave the tracks are of 9 foot gauge. The rails are of steel. In the choir the track is 10 feet wide, and the outer rail is curved according to the arc of a circle of $22\frac{1}{2}$ feet radius. The radius of the inner rail is $10\frac{1}{2}$ feet. Between the two rails there is a rack, over the lateral faces of which run rollers which prevent derailment. The shunting car (Fig. 2) consists of a metallic frame $1\frac{1}{4}$ feet in height, rendered stiff by means of cross pieces, stays, and braces, and supported by five external wheels, which are keyed to five small axles running in the direction of the track's radius. The longitudinals are 21 feet in length. They are provided at their extremities with steel plates which, when the car is in contact with the stationary track, rest upon slightly inclined steel braces which prevent the car from tilting at the moment the crane is getting on the rails. At this moment, moreover, the apparatus is connected with the stationary track by a hooked tappet fixed to the cross piece of the car. The throwing out of gear is done by hand; the throwing into gear is automatic.

Very ingenious arrangements have been adopted for rendering the crane and car independent.

This is done by means of strong forged iron bolts which slide in cast iron guides, and which bear against the flange of the crane wheels when the crane is on the car. These bolts are maneuvered through connecting rods (whose length may be regulated) and counterpoised levers arranged on each side of the car—one controlling the front bolts and the other the back ones. The bolts are disengaged when the lever gets beyond a vertical position. If the crane then comes on the car, a tappet fixed upon its longitudinal tilts the lever, the bolts abut against the flange of the hind wheels, and the engineman is made aware that the crane is nearly in place. Then, when the wheels leave the bolts, the latter are carried along by the counterpoises to their definite position. It will be seen, then, that the closing of the bolts is automatic. They are drawn back by hand. The tappet that works the lever acts in one direction only, by bearing against a stop.

The bolts are so arranged that they can be drawn back simultaneously at both ends; otherwise, through a false maneuver, the crane might possibly go beyond the car without meeting any obstacle. With the arrangement adopted it is certain that, when the hind bolts are drawn back so as to give access to the car, the front ones are out.

In fact, each driving shaft is provided on the side opposite the lever with a hand wheel and connecting rod which actuate a fork-link, and give a motion in a direction contrary to that of the corresponding lever. When the bolts are drawn out on one side, the link embraces the lever that controls the other two, and prevents it from being lifted.

The car is moved by the crane engine in the following manner: The last gearing that communicates mo-

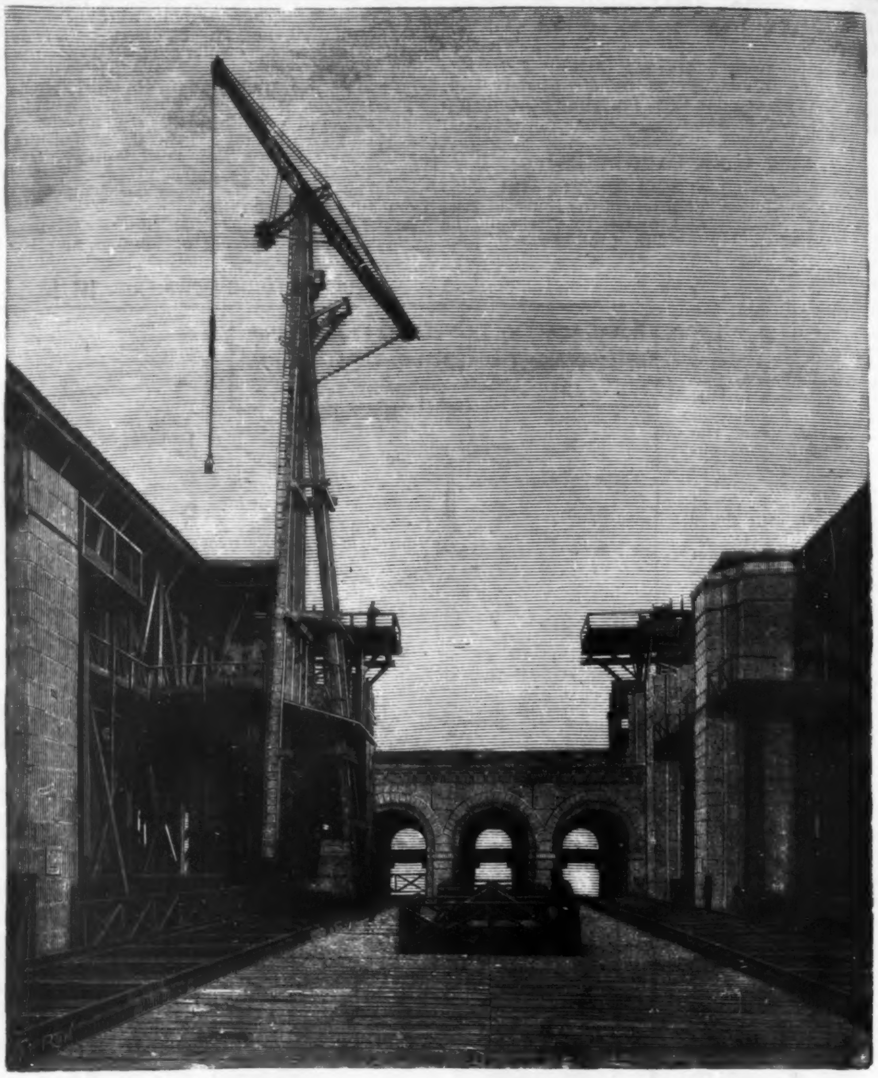


FIG. 1.—NINETY-EIGHT FOOT CRANE.

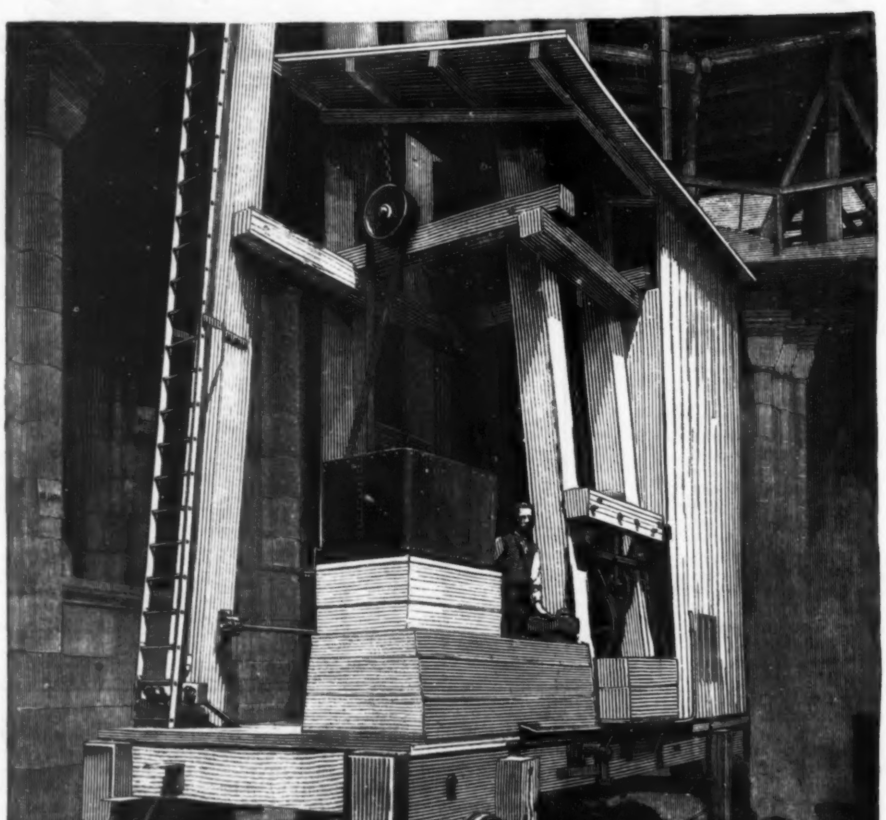


FIG. 2.—SHUNTING CAR.

tion to the driving axle of the crane is mounted loose thereon, and becomes fast only through a gearing maneuvered by means of a lever on the engine platform. When the crane is placed upon the car, this device is thrown out of gear, and is made to engage with a cog wheel that is capable of sliding upon an auxiliary shaft belonging to the car, and to which it is fixed by three keys. This auxiliary shaft of the car gives motion through a conical gearing to a shaft running in the direction of the track's radius. To this shaft is fixed another cone wheel that gears with a rack placed upon the floor between the rails. The same device, then, serves to communicate motion to the car and the isolated crane.

It now remains for us to examine the power, strength, and stability of the apparatus. The crane is calculated to resist the stress exerted by a load of 6,160 pounds, corresponding to the maximum bulk of the stones to be lifted. The total weight of the apparatus is 55,000 pounds, and this is sufficient to secure stability. It has been found that the center of gravity is at a height of 25 feet above the external rail, and at a distance of 3·6 feet from the vertical passing through this rail's axis. The resistant moment, then, is

$$55{,}000 \times 3{\cdot}6 = 198{,}000.$$

The moment of overturning is given by the load of 6,160 pounds, the balance being horizontal. In this position the axis of the rail, around which there is a tendency to revolve, is situated at 16·7 feet from the axis of the load chain. The moment of overturning, then, is

$$6{,}160 \times 16{\cdot}7 = 41{,}272.$$

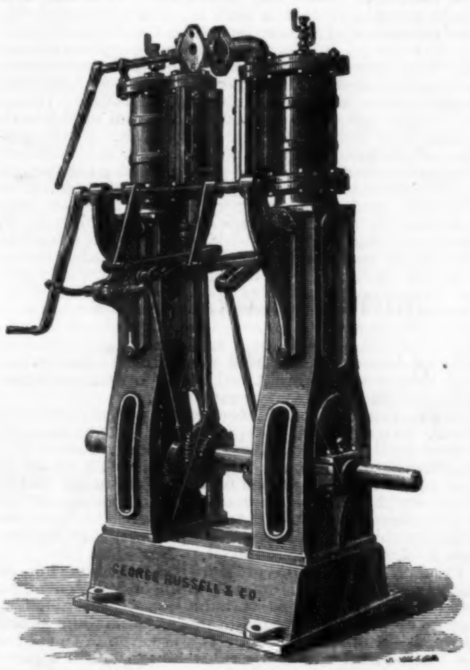
The ratio of the resistant moment to that of overturning is

$$\frac{198{,}000}{41{,}272} = 4{\cdot}79,$$

thus showing absolute security.—*Le Genie Civil.*

COUPLED VERTICAL ENGINES.

A VERY useful coupled vertical engine has been brought out and is manufactured by Messrs. George Russell & Co., of Alpha Works, Motherwell, near Glas-



COUPLED VERTICAL ENGINES.

gow. This engine, which is illustrated above, from *Iron*, is self-contained, and is fitted with a pair of inverted cylinders and link reversing motion. Our engraving represents one of these engines, with cylinders 6 inches diameter × 10 inches stroke. Power may be taken from the crank shaft projections at either or both sides. The sole plate measures 3 feet × 2 feet 3 inches over all, and the total height of the engine is 6 feet. The reversing links are of steel, and the eccentric straps of brass. The crosshead guides have very large surfaces, and the slide bars are adjustable and removable from the outside. The engines are made in various sizes, ranging from 5 inch to 12 inch cylinders, and have been used for various purposes, such as driving the live rollers in ironworks, to which and other similar purposes we should say they were particularly applicable.

EXPLOSION OF A MILITARY MINE AT ARRAS.

THE press was, not without reason, stirred up by the accident that happened Tuesday afternoon, Oct. 6, at the Arras mock battery during a sham battle executed by the Third Regiment. Quite a heavy charge of powder, having been lighted without any order, blew up a dozen men. The victims, thrown to a distance of over thirty feet into the air, were found buried beneath the earth, some of them dead, and others wounded. How did the accident happen, and what was the cause of it? This is a subject for examination; but before entering deeply into the matter, it will be well to say a word as to the general conditions under which a war by mines proceeds. The execution of the operations embraced in a contest of this nature forms a portion of the duties of the engineer corps. It follows from this that, with the exception of the officers of the sappers and miners, not many specialists, and still fewer professionals, are to be found in the army. The nature of such operations, moreover, we believe to be but little known to the public, and so a short account of the matter will not be judged here out of place.

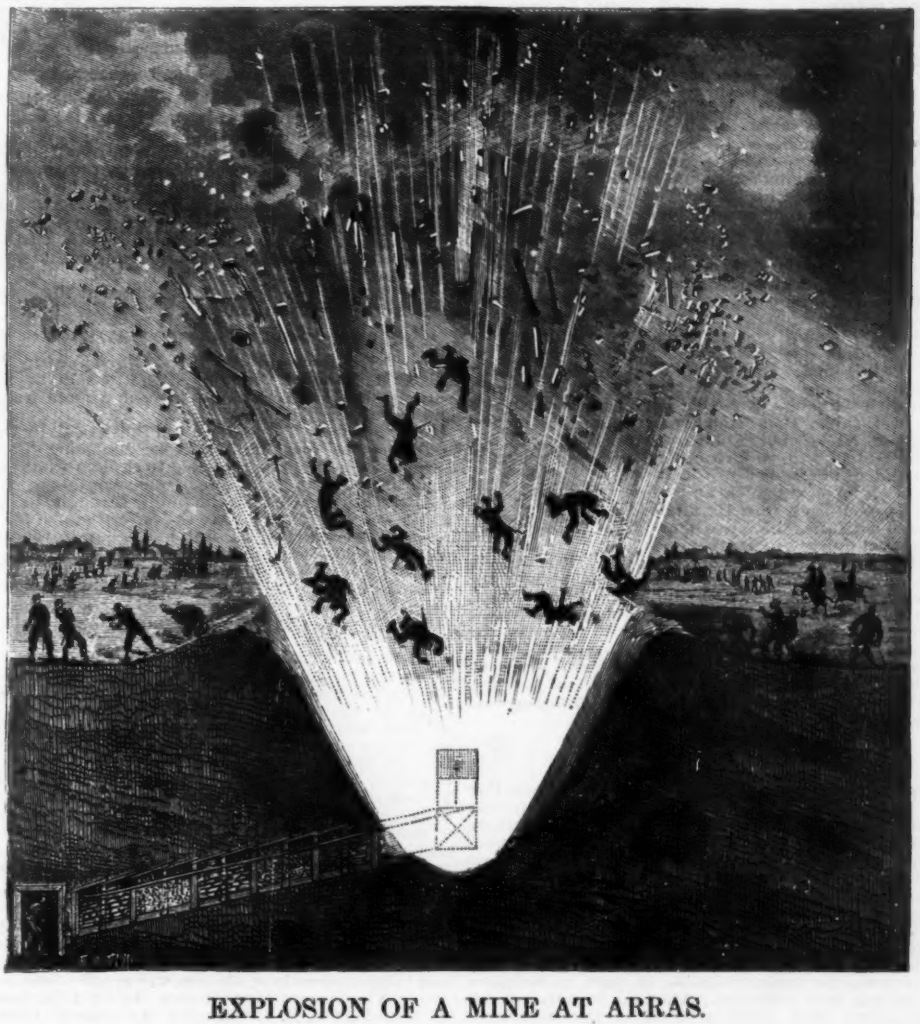
The origin of the art of subterranean warfare is lost in the night of ages. A very curious passage in the Bible proves that strongholds were taken by mines as long ago as about B. C. 2000. This art was practiced with success by all the peoples of antiquity—Assyrians, Hebrews, Persians, Greeks, and Romans.

Historians and didactic authors have left us a host of documents touching the processes of the miners of their time, an analysis of which would permit of a very complete history of the art being written. We can here indicate only the essential principles of it.

The subterranean wars of antiquity aimed at two distinct objects: either the assailant endeavored to pass by galley beneath the foundation of the wall of the besieged fortress, or else he stopped under the wall for the purpose of ruining the face of it.

It was by the first of these two methods that Darius captured Chalcedonia, Camillus, Veii, and Alexander, the capital of Sabus. A process of this nature could only be somewhat successful while it was new; for as soon as it became known, the defender put himself on the alert, and awaited his adversary at the mouth of the subterranean trench, which was always narrow and incommodious.

The second method was the one that was more commonly employed. The assailant began by forming his parallel at about sixty yards from the place to be taken, and then, under this cover, sank a well and



EXPLOSION OF A MINE AT ARRAS.

opened a gallery at the bottom of it. This gallery was driven as far as to the ramparts. Having thus got beneath the wall to be destroyed, the miner temporarily propped up the base of it with wooden framework. The excavation and timbering beneath the wall usually extended to a distance of about sixty yards. The spaces between the props were filled in with dry wood, brush, or other combustible materials, which were then smeared with tar, pitch, or, better, a resin called galbanum. This wood-filled chamber was then set on fire, and, when the props were once consumed, the wall fell in, the inclosure was open, and the assaulting columns rushed forward.

The approaches were not always subterranean, but were sometimes effected in covered trenches dug at the surface, or under movable coverts. These surface trenches were known generically as "vines." A specimen of them may be seen among the reliefs on Trajan's column. The rolling coverts were called "tortoises." A representation of them, agreeing with the description given by didactic authors, is to be seen in several Egyptian and Ninevite bas-reliefs in the Louvre Museum. For the purpose of preventing these various means of attack, the defense extended his wall down to bedrock or to the water, and cemented the foundations in such a way that that portion of the masonry which was suspended over the gap was capable of remaining in place by reason of its cohesion with the neighboring parts. Sometimes the besieged waited underground for the assailing miner to make his appearance under the wall, and sometimes, too, they proceeded underground to meet him, and thus proceeded by countermining. Some strongholds of antiquity were provided with permanent countermining arrangements.

We can figure to ourselves the result of a contact of the adversaries, and, to a certain point, we can restore the aspect of an ancient subterranean combat. The counterminer falls abruptly into the gallery of the assailant, barricades himself therein, and obstructs it with pieces of rock or interrupts it with herissons formed of spears and javelins. He throws into it projectiles of all kinds—iron javelins, blocks of stone, fire-hardened spears, burning pitch, and stinking materials, and also auxiliaries taken from the animal kingdom, such as wasps, snakes, or deer. The assailant perseveres, and hence proceed hand to hand fights in which the assailing miners often meet a common end.

The middle ages proceeded absolutely in the same way as did antiquity. The miners of Charlemagne, of the Normans of the ninth century, of Philip Augustus, and of Duguesclin, approached the ramparts that they were besieging either by a subterranean gallery, by covered trenches, or by movable coverts; they halted under the wall to be mined, and they erected a framework and set fire to the props. But the nomenclature was not the same. The subterranean gallery was called "cliban," the surface trench "taudis," and the movable covert "mole" or "cat." As for the timbered entrenchment that the defenders formed at the probable mouth of the assailants' gallery, that was called "breteche;" these are the sole differences to be noted.

The discovery of powder was to produce, and did in fact produce, a revolution in the art of subterranean warfare. From the middle of the fourteenth century, fortresses have been carried by explosive mines.

The limited scope of this study will not allow us to follow the progress of this new art of war step by step, and we must content ourselves with mentioning a few of the principal sieges during which the miner has played an important part: they are those of Candia (1669), Turin (1706), Schweidnitz (1762), Valenciennes (1793), Valence (1812), and Sebastopol (1855). Others might be cited.

And now a word as to the processes at present employed. A military mine consists of a certain quantity of explosive material which is located beneath the surface, and which, when properly fired, produces destructive effects. By extension, we call the subterranean galleries that lead to the "fourneaux" (that is to say, the chambers containing the charge) by the same name.

A system of mines is the subterranean communications in general that are opened up by a besieger. The permanent system organized by the defender is called a countermine arrangement. The latter is designed to ruin the works of the attacking party in measure as they proceed; the former, to destroy the countermine of the adversary, in order that an approach may be made in safety. The principal thing relied on by both is the "fourneau." Let us analyze the operation of this. At the moment the firing is effected, the deflagration of the subterranean powder gives rise to a relatively large volume of gas at a high temperature (2,400°), and this gas compresses the surrounding earth in every direction; hence both external and internal effects. We first observe a violent trembling of the contiguous ground, which does not quiet down until the earth over the "fourneau" gives way to the upward thrust. From this action results an upheaval; and the excavation left by the earth thus thrown up into the air is called a "funnel," by reason of its form. But this form lasts but an instant, for the earth, in falling, partially fills the funnel, and forms around its circumference ridges called "lips." In the interior, the operation of the "fourneau" exerts a ramming action in every direction, and consequently a breakage. It is possible to pretty accurately determine the limits between which it is

thus possible to destroy the subterranean works of the enemy.

The principal passages that lead to the "fourneaux" are called "galleries" or "ecoutes"; and the secondary ones, "branches." To prevent these subterranean passages from caving in, recourse is had to masonry lining if the arrangement is to be permanent; otherwise, to planking. At present, these galleries are lighted by electricity, and ventilated by improved apparatus driven by this same agent. It is also electricity that permits of instantaneously firing the charge at the proper moment. To this effect, conductors arranged along the galleries and branches end, on the one hand, at the electric source, and, on the other, in the center of the powder.

When a chamber is charged, it is necessary to close up the communication to it. The object of this is to prevent the explosion from producing any effect in the branches and galleries. The tamping consists of obstacles which, on the side toward the gallery, oppose a greater resistance to the action of the gases than that which they meet with on the side where it is desired to make them exert their action. These obstacles consist of earth and wood, unburnt bricks, bags of earth, or earth and turf.

As regards the organization of a system of countermine fourneaux, the arrangement that now prevails is what is called "fan ecoutes." It consists of a series of slightly divergent galleries, about twenty yards apart, which present themselves *upright* to the enemy. These ecoutes all branch from a gallery called the "counterscarp." Then from each ecoute start other branches, each of which slopes upward, forms a landing place, and returns parallelly to the ecoute, and rises again to the height of the fourneau, which is usually 12 or 15 feet beneath the surface of the ground. The distance apart of the branches is so calculated that the circumferences of the forneau funnels shall be tangent to each other, or, better, intersect each other. In this way there is no point of the ground that cannot be blown up. There are certain processes, moreover, that permit of submitting the same point to the effect of several successive explosions.

Informed as to the state of the enemy's walls, by observers, the commandant can, at will, fire any one of the fourneaux numbered upon his map. He has only to place his finger upon the desired key, when an explosion will instantly occur, and a vertical projection of the glacis be observed. Our engraving represents a scene of this kind. Underground, to the left, is seen in section an ecoute from which starts a sloping branch filled with tamping. An explosion has just occurred, and everything that stood on the surface of the dangerous circle is being blown heavenward—gabions, fascines, tools, and, unfortunately, men also. This is the accident of October 6.

Most of the poor sappers and miners who were thus blown up fell back into the funnel, where they were covered with the falling earth, and it became necessary to proceed quickly to dig them out.

What was the cause of this explosion? it is asked. It was due to some imprudence of the miner whom our engraving represents standing in the ecoute, into which pass the conductors that lead to the center of the powder and the source of electricity. Have unexpected currents—derived or induced—due to the operation of the Edison electric light apparatus, been produced in the firing device? This will be taught us, perhaps, by the investigation of the matter now pending.—*La Nature.*

TISSUE COLORING.

AT a recent meeting of the Physiological Society, Berlin, Prof. Ehrlich made a communication on physiologically important results he had obtained from his investigations into the susceptibility of the different tissues to coloring matters. If coloring solutions—in particular methylic blue—were injected into living animals, and then, with the utmost expedition, particular tissues were examined, interesting reactions of the living tissue under the coloring materials would be perceived, which, in spite of their rapid evanescence, revealed important facts which by other methods were in part wholly unascertainable, in part to be ascertained only with difficulty. After the injection of methylic blue, Prof. Ehrlich found in the submucous tissue of the tongue very numerous fibers and fibrous reticula colored intensely blue, which sent processes to the epithelial formations, and it was easy to determine that these fibres were the axis cylinders of the sensory nerves. These blue-tinged axis cylinders were found very numerously in the gustatory cuplets, at the basis of which they formed a quite narrow reticular network, whence, then, single fibers ending in knots proceeded anteriorly to the ciliated cells. Network of blue fibers were found very copiously and closely in the cornea. The iris likewise showed blue plexuses, particularly on the anterior side; on the posterior side only long cancellated reticula were observed. In the muscles, on the other hand, were found only detached blue fibers, the ending of which in the muscle fiber could not be established. The axis cylinders of the motory nerves were, according to this experiment, not colored by methylic blue during life; it was only the sensory nerves which reacted to the coloring matter. The vessels, arteries, capillaries, and veins were surrounded by blue plexuses. It could not, however, be decided whether the blue fibers proceeded to the smooth muscle cells. In the retina the nervous layer showed no blue coloring. In the ganglion layer, on the other hand, cells richly charged with blue, and having numerous branching processes, were found, which, too, were in communication with the processes of neighboring cells. In the mixed nerve stems and in the roots of the nerves no blue fibers were found. The central ends, on the other hand, showed a decided methylic blue reaction, as did also the peripherical ends of the sensory nerves. In the brain, blue fibers were found only rarely, but were very abundant in the medulla oblongata, while they were wanting, again, in the spinal marrow; and from these results it appears that the coloring of living organs with methylic blue was a very important means toward observing the endings of sensory nerves in them. It must, however, be borne in mind that the examination had to be prosecuted very rapidly after the coloring process, because, in living tissue, the coloring material got very quickly—in the course of a few minutes—lost by diffusion, and the coloring of the axis cylinders disappeared.—Dr. Benda laid before the Society several preparations sent by Prof. Adamkiewicz, of Cracau, and gave an explanation of them. After coloring with saffranine, Prof. Adamkiewicz found, in transverse sections of nerve fibers and cords of the spinal marrow within Schwann's sheaths, yellow to brown colored crescents, which were sections of peculiar fusiform cells, and in the opinion of Prof. Adamkiewicz represented hitherto unknown parietal cells, lying within the nerve fibers, distinguished by their saffranine reaction.

THE AMERICAN PUBLIC HEALTH ASSOCIATION.

THE thirteenth annual meeting of this association, held from Dec. 8 to 11, Dr. James E. Reeves of Wheeling presiding, at Washington, D. C., proved to be one of great interest, and was very fully attended, among those present being the Surgeon-General of the army and of the navy. Many papers and reports of great value were presented, but almost all were characterized by great prolixity, so that anything more than a mere outline report would require much space to present it. The volume of proceedings, usually a bulky one, will this year be even more so than usual.

Representatives of several State boards of health met separately; and by resolution of the Public Health Association, they will be hereafter recognized as a subsection, and will meet on the day preceding its meeting, and will also have set apart for them a day or part of a day during the time of the meeting.

REPORT OF COMMITTEE ON DISINFECTANTS.

Perhaps the most valuable of all contributions to science at this meeting was the elaborate report of the committee on Disinfectants, of which Major George M. Sternberg was chairman, giving details of the varied and careful experiments conducted by the committee, together with the conclusions arrived at concerning the relative value of disinfectants. These results have been already given in full in the SCIENTIFIC AMERICAN. The committee was continued another year, with some additional members, and was ordered to consider especially the disinfection of sewers.

The following papers were presented at the opening session on Tuesday morning:

ON NOMENCLATURE AND STATISTICS.

On "Sanitary and Statistical Nomenclature," by Dr. E. M. Hunt of Trenton, N. J., in which he made various suggestions looking toward a more accurate and uniform terminology.

On "Forms of Tables for Vital Statistics," by Dr. J. S. Billings of Washington. After discussing different forms now in use, he proceeded to explain what ought to be included in or rejected from such tables. Vital statistics are furnished to the public through the press, and he urged that it was the wisest course for the health officer to furnish full and accurate reports of prevailing sickness and deaths every week, so far as he has the data to do so, and thus avoid the responsibility of concealment. Dr. Billings said there were several sources of information with regard to the amount and character of disease prevailing in a city of which the health officer can, with a little tact and management, avail himself, and which are too much neglected. There are the public dispensaries and other institutions for the treatment of the sick, including the city physicians to the poor, the prisons, reformatories, and asylums, and the public schools. From all of these, which are supported from the public funds, he should be able to obtain reports showing the amount and character of the diseases coming under their notice. In conclusion, attention was called to the importance of using graphic representations of the results of studies of vital statistics, to be given in the form of diagrams and shaded maps, which, although rather expensive, would be found cheaper and more satisfactory in the end.

ON CHOLERA AND HOG CHOLERA.

On "The Relations of Rainfall and Water Supply to Cholera," by Dr. Henry B. Baker of Lansing, Mich., taking the position that where water supply was good and rainfall abundant, cholera was greatly decreased.

On "The Virus of Hog Cholera," by Dr. D. E. Salmon of Washington, D. C. During the present year, he said, the ravages of hog cholera have been unusually widespread and severe, costing the country nearly $30,000,000. The disposition of the millions of carcasses of hogs that have died from this disease is a matter which affects the health of our people. Sometimes the carcass is left to putrefy in the open air, to be preyed upon by carnivorous animals and birds; sometimes it is thrown into the ponds and streams which furnish drinking water to our cities; sometimes the lard is rendered from it, and what becomes of this product is an interesting subject for speculation. Only exceptionally are the carcasses burned or buried. The study of virus is of peculiar interest to us at this time because of its bearing upon the general subject of contagion. The science which treats of this important class of phenomena is still in its infancy, but experiments are in progress which will undoubtedly result in decreasing the disease. The paper led to animated discussion between Mr. Erastus Brooks of New York and Dr. S. S. Verdi of Washington on the bearing of hog cholera on the export trade.

ADDRESSES OF WELCOME AND PRESIDENT'S ANNUAL ADDRESS.

At the evening session addresses of welcome were made by Dr. J. M. Jones of Washington, chairman of the Reception Committee, and by Hon. J. B. Edmonds, President of the Board of Commissioners of the District of Columbia. President Cleveland, in an appropriate and autograph letter, regretted his inability to attend. His "expression of regret," he says, "is not merely formal, but actually indicates a sense of deprivation which attends an inability to give, by my presence, as requested, the fullest indorsement of the objects and purposes as well as the work of the Association."

The President of the Association, Dr. James E. Reeves, then delivered his annual address. He directed attention to the subject which has occupied the most industrious energies of his life, namely, the public health. He said that every such assembly as the one he addressed to-night moves forward another day's journey the ark of the sanitary covenant, and humanity is bettered and made happier thereby. In these days of political struggle and divers interests, we hear much of the various means for the advancement and protection of the agricultural, manufacturing, mercantile, and many other interests of less extended importance.

What question of mere business interest can compare, either in importance or extent, with the general and individual interest which every man has in the preservation of health and life. The National Legislature is liberal in many matters, and ought to be equally liberal in providing for the public health. On this point he said:

"We are to-day at the very threshold of great possibilities in preventive medicine, and the central Government should foster every effort for the success of the work in which sanitarians are so heartily engaged. To aid them in the study of contagious or infectious diseases, both among human beings and animals, and the blights upon the crops, a national biological laboratory should be provided; and no other place would be so well suited for the location of such a school of science as the new building now in process of erection for the Army Medical Museum and Library. With a thoroughly equipped national school of biology, our scientists would not then have to visit laboratories abroad—to Pasteur in Paris, Klein in London, and Koch in Berlin; neither should we then see our distinguished Sternberg quartered at the Johns Hopkins University in Baltimore for favorable facilities for the study of micro-organisms in relation to disease."

Dr. Reeves expressed the hope that the present Congress would be influenced to establish a health bureau, which would prove a blessing to the whole country.

On Wednesday papers were read as follows:

ON SMALL-POX IN CANADA.

On "Small-pox in Canada, and the Methods of dealing with It in the Different Provinces," by Dr. P. H. Boyce of Toronto, Secretary of the provincial Board of Health. After stating that he felt like a lawyer before a criminal court pleading for an accused person who has boldly declared himself "not guilty" of an epidemic of small-pox, he proceeded to detail the history of the outbreak the present year, stating that it was not until after a prominent politician had died of the disease that the outside world and Montreal itself awoke to the situation. The origin of the epidemic was traced to some part of the United States. The whole number of deaths thus far was 3,001, and the whole number of houses in which the disease was reported was 3,141, making the average nearly one disease for every house. Unfortunately, the epidemic was not confined to Montreal. Among the French *habitants* there was no adequate system of sanitation. Hence the disease spread in every direction, and local health boards were obliged to guard against it. In the province of Ontario a very stringent system was adopted. All goods, merchandise, and people passing into or out of the province were strictly examined. The railways afforded invaluable co-operation. Every car was examined, and all railway officials vaccinated. In stations along the road which proved recalcitrant to the health authorities, the railroads passed without stopping trains till health regulations were conformed to. Where merchandise was satisfactory to the authorities, certificates were issued, which enabled trade to be carried on without interruption. All baggage belonging to passengers who came from the neighborhood of infected houses in Montreal was carefully fumigated, and themselves quarantined; but others were not subjected to unnecessary annoyance.

In the province of Quebec, equal precautions were taken. In conclusion, the speaker said that he thought it very creditable to Ontario that it had succeeded in establishing an internal quarantine through which no case of disease had passed to the neighboring States. He thought that the common sense of justice of the Association would lead it to agree with him that the unreasonable continuance of the quarantine at Suspension Bridge should be removed.

Dr. W. H. Hingston of Montreal, commenting on the paper, said that Montreal had been afflicted as no city on this side the Atlantic has ever been afflicted. But no city could have made more tremendous efforts to free itself of its affliction. It was through the aid of the United States that the rules for vaccination were enforced more thoroughly than would otherwise have been possible. Montreal had to create legislation for itself, on account of its distance from the seat of government; but in some cases the rules were sent to Quebec by special messenger, and became laws within forty-eight hours. No province could have done more to rid itself of its epidemic than had Quebec. There were no hospitals nor isolated buildings in which patients could be placed till after the outbreak of the epidemic. Disinfection after the most approved methods was employed.

The opposition of the French to vaccination has developed within about thirteen years, during which time anti-vaccination publications have been circulated. Prior to that time nearly every one was vaccinated; but at the outbreak of the epidemic, most of the children below the age of thirteen were not vaccinated. The French are very prolific. From the 60,000 French *habitants* at the time of the cession to Great Britain have sprung 1,700,000, now resident in Canada and the United States. Large families are still the rule, so that in order to estimate the number of houses which have been afflicted by the epidemic, you must divide the number of deaths by five or six, that being about the average number that have been taken out of each family where death has entered at all.

A protracted discussion ensued, especially on the subjects of compulsory vaccination, purity of virus, and vaccination of both sides of the body, which several members recommended.

ON CAUSES PREDISPOSING TO PULMONARY DISEASE.

Dr. C. W. Chancellor, Secretary of the State Board of Health of Maryland, read a paper on "Impure Air and Unhealthy Occupations as Predisposing Causes of Pulmonary Consumption." He stated that in England one fifth of all the deaths occurring are from pulmonary consumption, in France one-sixth, and in Germany and Austria about one-seventh. In the census year of 1880, one-eighth of the deaths occurring in this country were from consumption. The causes which lead to this fearful mortality demand more than ordinary consideration.

Pure air is as essential to the health and vigor of the animal system as wholesome food and drink. When

contaminated by stagnation, by breathing, by fires or artificial light, such as candles, lamps, or gas, it operates as a slow poison, and gradually undermines the human constitution. Because air is an invisible substance, and makes little impression on the organs of sense, people seem to act as if it had no existence. Too little attention is paid to proper ventilation of living apartments. In some houses, the windows are unopened for weeks and months together. Crowds of tailors, weavers, seamstresses, shoemakers, and other mechanics employed in sedentary occupations, are frequently pent up from morning till night in close and sometimes damp apartments, without even thinking of opening their windows for a single half hour for the admission of fresh air. Consequently, they are continually breathing an atmosphere highly impregnated with the noxious gas emitted from the lungs and the effluvia perspired from their bodies, which is most sensibly felt by its hot, suffocating smell when a person from the open air enters into such apartments. The sallow complexions of such persons plainly indicate the injurious effects produced by the air they breathe; and although its pernicious effects may not be sensibly felt, it gradually preys upon their constitutions, and often produces incurable consumptions, which are frequently attributed to other causes.

It cannot be denied that some occupations are more unhealthy than others. There can be no doubt that the inhabitants of cities are less hardy and more subject to pulmonary disease than those of the country. City people, speaking generally, are pale, of lymphatic temperaments, and their muscular system is but poorly developed. Want of free circulation of a pure, uncontaminated atmosphere is the most powerful cause of this. In addition to this, in cities, the passions are more excitable; indulging in eating and drinking is more common; with many, life is sedentary, and the occupations are altogether more unhealthy than those in the country. Take, for example, those engaged in mercantile life—merchants and clerks. These, for sanitary purposes, may be divided into three classes—first, those who have but little exercise, such as book-keepers; second, those who have exercise, but are confined to their stores in a superheated, unhealthy atmosphere, as, for example, salesmen; and third, those who have exercise in the open air, or who do out-door work. In the first class, the digestive organs suffer, the next suffer from diseases of the pulmonary organs, and the third from the prostrating effects induced by mental or bodily overexertion or by corroding care.

Salesmen are liable to their diseases because they are constantly exposed to their exciting causes, the principal of which are an impure atmosphere and exposure to sudden changes of temperature.

Referring to artisans and laborers who work in the manufactories and shops, many of which are badly located, badly ventilated, and often abounding in dust, under such circumstances the most substantial nourishment and the most temperate habits cannot prevent their becoming blanched and weakened by disease. Persons habitually breathing a dust-ladened atmosphere, as in some manufactories, are more especially liable to pulmonary complaints. The average duration of life among the dry grinders of forks is twenty-nine years; of razor grinders, thirty-one years; edge tool grinders, thirty-two years; knife and file grinders, thirty-five years; and saw and sickle grinders, thirty-eight years. In every hundred sick among the needle makers, seventy are consumptive, and among the file makers, sixty-two; and taking the steel grinders all around, rather over forty in the hundred are consumptive, while one-half of the lithographers—workers in copper—have the disease. Grindstone makers rarely live over twenty-four years, and the average life of the flint cutter and glass polisher is under thirty years, and that of the stone cutter thirty-six.

Of workers in vegetable dust, cigar makers, tobacco and snuff workers have an average life of fifty-five years, but head the list of consumptives with thirty-six in a hundred. In textile fabrics, the weavers of cotton, flax, and hemp are the chief workers. Three-fifths of the flax workers of Belfast, Ireland, are consumptives. The average life of weavers in this district is only forty-four years, in other districts fifty-seven years. Of carpenters, joiners and cabinet makers, 14 per cent. are consumptive. Coal miners do not suffer so severely as is generally supposed, the coal dust being an antiseptic.

Of workers in animal dust, the percentage of consumptives is: brush makers, 49·1; hair dressers, 32·1; skinners, 23·3; tanners, 16·2; hatters, 15·5; button makers, 15; harness makers, 13·8; cloth makers, 10.

The problem how to face this evil is simply how to environ each worker in the prosecution of his work with a pure atmosphere. The solution of the problem could be easily suggested by the sanitary engineer, but its execution is a matter for the legislatures of the several States. In the mean time, it is extremely desirable, and even necessary, that consumptive hospitals should be established in every city. London has its half dozen, and other European cities are not without some provision, but in this country, even in many of the larger cities, no provison is made for so necessary an object. It would be a great and truly useful work to devote an edifice in every large city to so benevolent a purpose.

(*To be continued.*)

THERAPEUTICAL EFFECTS OF TOBACCO

By I. J. M. GOSS, M.D., Marietta, Ga.

Toxical Effects.—Before giving the therapeutics of tobacco, it will be appropriate to give its toxical effects. A large dose of tobacco produces nausea, vomiting, purging, and great prostration, and even faintness. It confuses the mind, dims the vision, enfeebles the pulse, and produces a cold, clammy sweat. In lethal doses, tobacco paralyzes the brain and destroys voluntary movement; but it excites the medulla oblongata and the cord, producing first tetanus, which soon subsides, and is followed by paralysis of the motor nerves. The sensory nerves are not affected. Nicotine is the most active constituent of tobacco, which is combined with malic acid, and is an oily, colorless, alkaline liquid. It contains another principle—nicotianine. It is compatible with alkalies, tannin, the iodides, and strychnia, ergot, digitalis, belladonna, ammonia, alcohol, and all stimulants.

For poisoning by tobacco, an emetic should be given, or the stomach pump should be used, and tannin and the iodides given to counteract the nicotine, and ammonia given to keep up the circulation until the poison is eliminated from the system.

Synergists.—All nerve depressants increase the effects of tobacco. Nicotine acts very quickly, much like prussic acid in its intensity. It is reported by Taylor to have produced fatal results in three minutes after a lethal dose.

It paralyzes the respiratory muscles before those of the heart, yet it slows the circulation, but it is by its action upon the pulmonary nerve center. It has been applied to the muscles of the heart after death, and was found not to impair its contractility. It quickly lessens oxygenation, hence its value in certain forms of inflammation, and in certain forms of fever yet to be mentioned. It produces colic in lethal doses, but cures it in medical doses. It produces spasms in overdoses, but cures them in medical doses. Its ultimate effect is to paralyze certain parts of the motor system, but there is a stage of tetanus that precedes this profound relaxation. The end organs of the motor nerves lose their excitability, then the trunks of the nerves, then the spinal cord, but the muscular irritability is unaffected. The pupils are contracted by large doses, and are insensible to light. It decidedly reduces the temperature of the body.

The kidneys rapidly eliminate the nicotina. But lethal doses may produce death so quickly that the above symptoms do not all occur. The patient may simply become very sick, stare wildly, fall, and expire with simply a deep sigh. Others, who take less of the poison, may have most or all of the above symptoms.

Therapy.—One of the beneficial effects of tobacco is its arrest of the secretion of milk in the breast. For this purpose a poultice is applied to the breast until it produces the desired effect or produces nausea. It readily relaxes the tension of the skin and muscular or fibrous tissues, and thereby relieves the pain of most, if not all, superficial inflammations. For this purpose, an ointment of tobacco, made by boiling 1 ℥ of tobacco in eight ounces of olive oil, will be very convenient to apply. It should not be applied to the abraded skin in large quantities, as it is readily absorbed, and produces fatal results quickly. Habitual constipation may be relieved by taking 5 gtts. of the wine of tobacco at bed-time. Strangulated hernia may often be overcome by an enema of tobacco, say 1 to 2 grs. of tobacco infused in a gill of water, which may be repeated until nausea ensues, or until it produces the desired effect. It is a prompt remedy where paresis of the muscular layer of the bowels has caused impaction of the cæcum, and also in painter's colic. It gives relief in spasmodic asthma. My friend, Crawford W. Long, M.D., of Athens, Ga., told me that he kept off asthma by smoking tobacco regularly. I have used the snuff plaster with success in *laryngismus stridulus*, applied to the neck and breast for a short time. Obstinate hiccough may be relieved by 5 gtts. of the wine of tobacco; yet large doses cause it. We have no remedy equal to this in tetanus. For this purpose 4 ℥ of the infusion may be used as an enema, repeated, if it fail to relax the contracted muscles. It has also proved successful in strychnia poisoning. It may be given by the mouth or by enema, or even by hypodermic injections, in proper quantities. It overcomes satyriasis very readily, and often checks nocturnal pollutions, due to repletion.

Locally applied over a small surface, it has cured* tinea, scabes, prurigo, pityriasis, and other like skin affections. An ointment of tobacco relieves the pain of hæmorrhoids and the itching of pruritus.

Gen. T. L. Clingman, of Asheville, N. C., in his little pamphlet on tobacco, says that it will cure sclerotitis in men or horses, by applying the juice in the eyes. Gen. Clingman also used it upon himself for a severe sprain of the ankle, which was greatly swollen and very painful. He applied the leaves of the tobacco under a moist poultice, which he says relieved the pain so he dropped to sleep in an hour; and upon examination of the ankle next morning, the swelling was also gone, and the skin appeared pale and wrinkled. During the late war Gen. Clingman received a gunshot wound in the leg; the ball entering near the ankle and passing out just below the knee, making a very painful wound. He applied the tobacco to the leg (which was greatly swollen, and very painful), keeping the tobacco wet by cloths over it. The pain was diminished in an hour or two, and the heat and throbbing ceased, and the limb had but little pain it, and finally got well. He also states that he received a blow on the right eye in an omnibus in the city of New York, in the summer of 1867, from the whip of the driver. The pain soon became very severe, the sight for the time was lost, the inflammation became excessive. He reached his hotel and applied tobacco over the eye, and secured it by a bandage, which was kept wet in cold water by dipping his face in a bowl of water frequently. The pain gradually diminished during the entire night so he slept. By morning, he says, he could see the outlines of the open window, and the redness had disappeared. He continued the tobacco most of that day, and until the fifth day, when the eye appeared natural and the sight was restored.

By his advice, Col. A. T. Davidson, of Asheville, N. C., who had violent inflammation of the eyes, applied tobacco on them with the very happy result of quickly relieving them of all inflammation.

Gen. Clingman also used a poultice of tobacco over his throat for sore throat with like success. He also relieved a lady of the like affection of the throat with the tobacco. And he states that his brother, a physician, has used it with success in eight or twelve cases of sore throat. Gen. Clingman also states that erysipelas of the head was readily relieved by the application of tobacco, kept wet on the skin. This he says he witnessed several times during life.

He states that he has seen it relieve bunions on the feet in a single night. He states that corns of the toes can be cured the same way.

Dr. Johnson says he has invariably cured his hogs of cholera with the infusion of tobacco in buttermilk. He also says he has cured tetter of long standing with it. Col. W. H. Burgwyne states that he cured a very painful boil with tobacco. My friend James Hughes, of Marietta, Ga., cured a large boil on his neck with the tobacco. Senator Z. B. Vance, of N. C., says he cured a bad contusion on his leg by the application of the tobacco.

I have, for many years, used the infusion of some two ounces of tobacco to the quart of water, as a remedy for colic in horses, seldom failed to relieve it with one-half this quantity, used as an enema. There is also on record where it cured a bone-felon. All the above cases were relieved with the leaf, but an extract or tincture is better.—*Eclectic Medical Journal.*

* See the author's practice for full treatment.

THE TREATMENT OF CARBUNCLE WITHOUT INCISION.

IN the course of the paper on this subject before the American Medical Association, by Dr. L. Duncan Bulkley (*Med. News*, May 9, 1885), the author related the case of a gentleman, aged 56, large and florid, who suffered for several years with eczema of the left foot. He was also diabetic. Following upon this eruption was a large carbuncle. He applied to this tumor, thickly spread on the woolen side of lint, the following ointment:

℞ Ergot, fl. ext	ʒ ij.
Zinci oxidi	ʒ ss.
Unguent. aq. rosæ	℥ ij.
M.	

Covering this with cotton batting, to prevent blows or injury. He was given sulphite of calcium ¼ gr. every two hours, and occasionally the following:

℞ Magnesiæ sulphate	ʒ iv.
Ferri sulphate	ʒ j.
Acid. sulphurici dil	ʒ iij.
Syr. zingiber	℥ j.
Aquæ, ad	℥ iij.

M. S.—Teaspoonful in water through a tube three times daily.

At bedtime Dover's powder was administered, to give rest when required. The result of the treatment was cessation of pain, rapid resolution, and a cure, except some induration, in eighteen days. The man continued at his work.

He summed up his paper as follows:

1. Avoid any irritation, as pressure, blows, etc.
2. Avoid warmth and moisture, as in poultices.
3. Avoid incisions.
4. Do not use stimulants.
5. Protect the inflamed parts with the ointment given above. The solid extract of ergot may be used if desired. Spread the ointment at least one-third inch thick.
6. Use sulphite of calcium every two hours for its effect upon suppuration.
7. Employ good, nutritious food and fresh air.
8. A sedative, if desired, and occasionally the laxative and refrigerant tonic as above.

The advantages are:

1. Short time required for recovery.
2. Cessation of pain.
3. No scar.
4. No operation.
5. No detention from business.

COLOR OF THE EYES.

AT the February meeting of the Swedish Anthropological Society, Prof. Wittrock read a paper on the hereditability of color of the eyes. The speaker had been requested by Prof. Alphonse de Candolle, of Geneva, to make observations on this point, which, together with those made in Switzerland, North Germany, and Belgium, had formed the material for M. De Candolle's paper, "Heredite de la couleur des yeux dans l'espece humaine" (*Archives des Sciences Physiques et Naturelles*, 3e periode, t. xii., Geneve, 1884). From the same the remarkable fact was derived that brown eyes were more common in men than women; of the individuals examined, 41·6 per cent. of men and 44·2 per cent. of women had brown eyes. Further, in families where the parents had the same color of eyes, 80 per cent. of the children of parents with brown eyes had brown eyes, while of children of parents with blue eyes 93·6 per cent. of them had eyes of that color. The unconformity was no doubt due to atavism, or the hereditary influence of ancestors. Of the children of parents of whom the father had brown and the mother blue eyes, 53·3 per cent. had brown, while where the reverse was the case 55·9 per cent. had blue eyes. As the percentage of brown-eyed children of parents with bi-colored eyes was highest, it seemed as if brown eyes were always on the increase to the detriment of blue ones. It appeared also from these researches that women with brown eyes have better prospects of marrying than those with blue. 52 per cent of the married women had brown eyes, and only 48 per cent. of them blue—a circumstance which is the more remarkable as the number of women with brown eyes in Italian Switzerland is only 44 per cent. Another remarkable discovery was that the average number of children of parents with eyes similar in color was 2·7, while that of those with different color was 3·18, which was an additional proof of the fact that children of parents with similar organization were as a rule of weak constitution.

Comparing the color of the eyes of the children where the parents were bi-colored with those of each of the latter, it was discovered that the eyes of the father were inherited by 48·8 per cent. of the children, and those of the mother by 51·2 per cent., which, divided between sons and daughters, showed that 47 per cent. of the former and 49·5 per cent. of the latter inherited the eyes of the father, whereas 53 per cent. of the sons and 50·5 per cent. of the daughters inherited those of the mother. Since Prof. Candolle had published his paper, he (the speaker) had continued his researches in Sweden, and from the material he had collected he had discovered results differing from Prof. Candolle's. Of the individuals reported to him, 29·6 per cent. of the men and 30·7 per cent. of the women had brown eyes, so that even in that country the latter were more numerous than the former, but this was no doubt due to the circumstance that he had been most anxious to obtain particulars from bi-colored parents. In accordance with Candolle' results, 75·6 per cent. of children of parents both with brown eyes inherited this color, while of those with blue eyes 97 per cent. inherited that color. It was but natural that this should be the case in Sweden, where blue eyes predominated. As regards the bi-colored parents, the case was different in Sweden too. If the father had brown and the mother

blue, 59·9 per cent. of the children had brown eyes, while where the reverse was the case 53 per cent. of them had brown eyes. These figures were the reverse of Candolle's. But of *all* bi-colored parents, 56 per cent. of the children had brown eyes, *i. e.*, that in Sweden too the latter are on the increase. He could not say what *rôle* the color of the eyes played in the selection of a wife in Sweden, as he had no statistics of the distribution of brown eyes in general, but there was a tendency similar to that stated above, as, of the parents embraced by these researches, the majority of wives had brown eyes. With reference to the number of children in Sweden of con-colored and bi-colored parents, that of the former was 4·49 and that of the latter 4·03, while 52·6 per cent. of the children inherited the eyes of the father and 47·4 per cent. those of the mother; of the sons, 51·8 per cent. inherited the eyes of the father, and 48·2 per cent. those of the mother, which figures as regards the daughters were respectively 53·5 and 46·5 per cent. This shows that in Sweden the eyes are not predominantly inherited from the mother alone, and that the offspring of equally constituted parents should not be weaker. The speaker stated in conclusion that he is continuing his researches. He excludes children under ten years of age from the same, and classifies blue-gray or gray eyes as blue.—*Nature.*

SIMULTANEOUS TELEGRAPHY AND TELEPHONY.

THE greatest success in the electric section at the Anvers Exposition was undoubtedly that which was obtained by the Van Rysselberghe simultaneous telegraph and telephone apparatus. Mr. Chas Mourlan showed a very complete collection of all these apparatus, which permitted of studying in detail their ingenious and wonderfully simple arrangements, while their practical working could be studied on the telegraph line running from Anvers to Brussels. In fact, lines for simultaneous telegraphy and telephony are numerous in Belgium, and daily communications are established by telegraph wires between telephone subscribers of Brussels, Anvers, Gand, Liege, and Mons, on the one hand, and between Liege and Verviers on the other

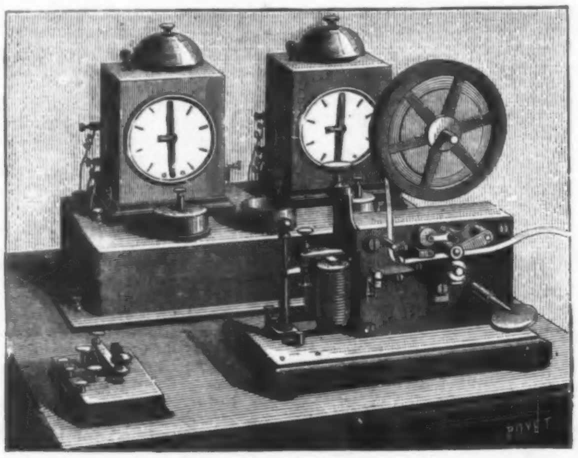


FIG. 1.—VAN RYSSELBERGHE'S TELEGRAPH APPARATUS.

To this effect, it has been necessary to protect the entire Belgian line against the induction that ordinary telegraph currents produce when they are traversing a telephone, or even when they are in the vicinity of telep' ne wires. But this expense of the first installation will, we believe, be quickly offset by the numerous advantages resulting from direct verbal communications between the subscribers of different cities, under conditions of simplicity, convenience, and ease that Belgium at present offers the only example of.

Without reverting to a technical description of the arrangements devised by Mr. Van Rysselberghe, to effect such double transmission, so paradoxical in appearance, let us briefly recall the principle of it.

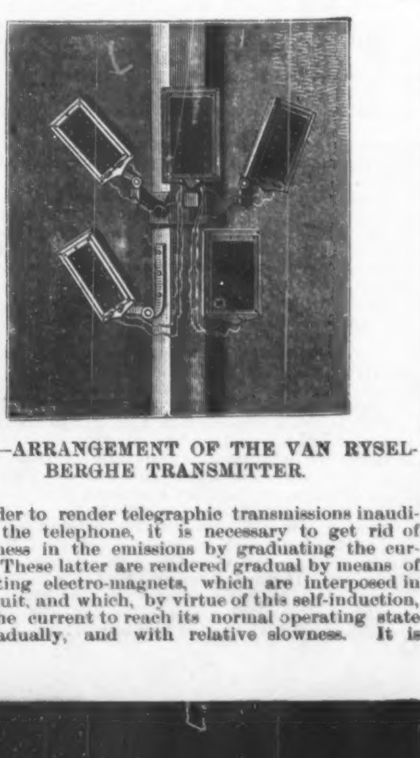


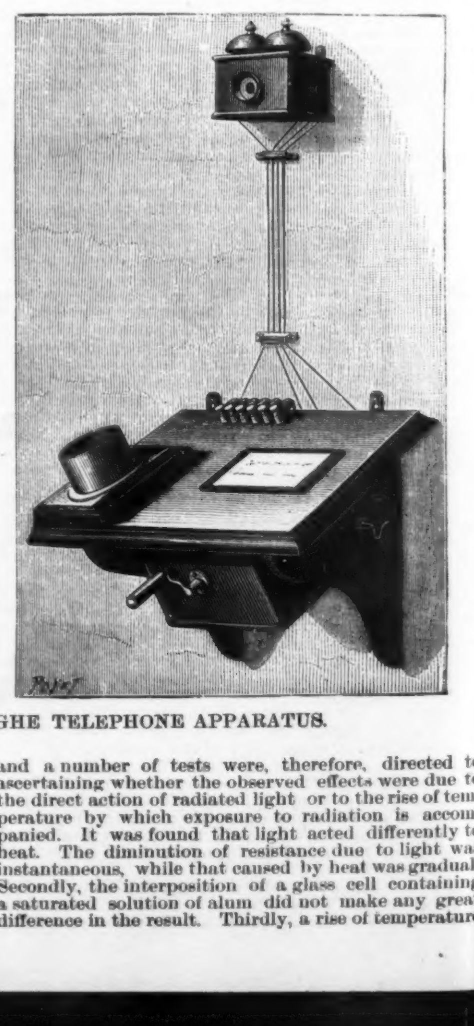
FIG. 2.—ARRANGEMENT OF THE VAN RYSSELBERGHE TRANSMITTER.

In order to render telegraphic transmissions inaudible in the telephone, it is necessary to get rid of abruptness in the emissions by graduating the currents. These latter are rendered gradual by means of graduating electro-magnets, which are interposed in the circuit, and which, by virtue of this self-induction, allow the current to reach its normal operating state but gradually, and with relative slowness. It is necessary to afterward separate the telegraphic and telephonic currents, so that the telephone circuit may give passage to the rapid undulatory currents of slight intensity used in telephony, without these currents passing into the telegraphic apparatus, upon which they would evidently have no action, and in which they would prove a pure loss.

It is necessary also to prevent the telegraphic currents from traversing the telephonic circuit, as this would create a detrimental derivation. This double result is obtained by means of separators. The rapid undulatory telephonic currents are arrested by separating electro-magnets, which do not allow them to reach the telegraphic apparatus. The telephone system, in which is interposed a separating condenser, is not traversed by the telegraphic currents. A completely independent double transmission is obtained, then, by a combination of electro-graduators, electro-separators, and condenso-separators. The electro-graduators are placed near manipulating apparatus, and the separating apparatus at the bifurcating point of the telephone and telegraph lines, that is to say, in the telegraph office, where it can be under direct and better surveillance.

In communications between cities, the receiving and transmitting apparatus are those employed at the houses of subscribers—the ordinary Blake transmitter and Bell receiver. For long distance telephony, Mr. Van Rysselberghe has devised apparatus whose general arrangement is shown in Figs. 3 and 4. The transmitter is analogous to the Ader microphone, but all the carbons are mounted in derivation upon the microphone board. Above the box that contains the induction bobbin, the magnetic call, and the commutation lever, there is fixed a cylindrical ebonite mouthpiece that permits of concentrating the sonorous waves upon the board and of thus obtaining a better transmission. In Fig. 4 the apparatus possesses the form of a desk that permits of writing the message received. This is more especially designed for public telephone stations and for telegraph offices, where every dispatch sent or received must be written.

Fig. 1 shows the arrangement of a telegraph apparatus provided with Van Rysselberghe's anti-induction device. It differs externally from the ordinary analogous apparatus only in the addition of a base containing the condensers and the electro-graduators and separators necessary for separating the two kinds of messages. These apparatus occupy but a limited space.



FIGS. 3 AND 4.—VAN RYSSELBERGHE TELEPHONE APPARATUS.

A delicate question concerning calls for stations and subscribers has been very happily solved by Mr. Van Rysselberghe by carrying out an idea suggested by Mr. Sieur. For these it was impossible to use either vibrating bells or what are known as magneto calls, because the currents necessary for actuating ordinary bells or magneto-calls would have interfered with the operations of telegraphy. It became necessary, therefore, to devise a phonic call loud enough to be heard at a distance, and even capable of producing a visible signal, such as the fall of an annunciator at the station called. The principle of the arrangement adopted consists in utilizing the undulatory currents emitted by a special vibrator, which causes the vibration of a telephone disk acting as a relay. When this latter is at rest, it closes the circuit of a local pile through the intermedium of a contact resting upon the disk. When it is vibrating, it produces in the contact a series of interruptions that open the short circuit of the pile and allow it to actuate an electro-magnet mounted in derivation upon its terminals. These rapidly interrupted currents have no action upon the telegraph system, while they are clearly perceived in the telegraph stations.

Such is, in its entirety and present practical form, the system of simultaneous transmission that the principal cities of Belgium have in use.

When once the system was established for ordinary telephone communications, it was an easy transition to apply it to the transmission of music, in order to permit a large number of auditors to hear at the same time. So, after transmitting the music of the opera from Brussels to Ostend, Mr. Van Rysselberghe got up some public exhibitions of musical transmission between Brussels and Anvers. Similar transmissions were effected on the 9th of July between the Vauxhall at Brussels and the Anvers Exposition.

The transmitters were arranged upon two of the pillars of the kiosk. Fig. 2 shows one of these pillars provided with five carbon transmitters—say ten in all. They were all mounted on a derived circuit, were actuated by an accumulator and connected with a single induction bobbin proportioned to the effect to be produced.

A special telephone apparatus permitted of corresponding with the employe in the auditorium at Anvers. It was only necessary to maneuver a commutator in order to transmit music over the line or connect the latter with the telephone. The calling was done with Mr. Sileur's phonic wheel. The line consisted of the two telegraph wires that connect Brussels and Anvers, and transmission to the latter place, at a distance of 23 miles, was effected without disturbing the regular operations of telegraphy.

The receiving apparatus were 70 in number, thus permitting 35 persons to hear at once and the same time. They consisted of the ordinary Bell magnetic telephone. They were located in a vast hall on the ground floor of the left light-tower of the Exposition, the hall in the right tower being set apart for listening to Dr. Ochorowicz's loud-speaking apparatus.

The success of these telephonic exhibitions was complete, and the credit of it is due to the inventor, the Executive Committee of the Exposition, and to Mr. Mourlon, who constructed and arranged the apparatus. This is the first time that a multiple transmission of the kind has been effected over telegraph lines in service to so great a distance and with so large a number of additions.—*La Nature.*

LIGHT VS. HEAT RADIATIONS.

THE experiments of Mr. Shelford Bidwell upon sulphur and certain sulphides, for the purpose of making an electrical resistance cell which shall be sensitive to light—*i. e.*, a sulphur instead of a selenium electrical photometer—have been partially successful. In the course of these experiments some noteworthy phenomena were observed. It was remarked that the resistance of most of these cells was diminished by heating; and a number of tests were, therefore, directed to ascertaining whether the observed effects were due to the direct action of radiated light or to the rise of temperature by which exposure to radiation is accompanied. It was found that light acted differently to heat. The diminution of resistance due to light was instantaneous, while that caused by heat was gradual. Secondly, the interposition of a glass cell containing a saturated solution of alum did not make any great difference in the result. Thirdly, a rise of temperature

sufficient to produce any sensible effect could not possibly have been caused by the amount of light which was able to diminish the resistance in a marked degree. Lastly, in the case of a cell composed of silver and silver sulphide in equal parts, light and heat produced opposite effects. A paraffin lamp at a distance of 18 inches diminished the resistance. But when the lamp was placed at a distance of only 10 inches, the needle of the galvanometer first moved in a direction indicating a further fall of resistance; and then, a few seconds after, when the temperature had begun to rise, it turned in the opposite direction. On again moving the lamp to a distance of only 4 inches from the cell, there was at once a large deflection, indicating increased resistance; the effect of the temperature completely predominating over that of light radiation. To show how little effect temperature had upon the action of the cells in comparison with the influence of light, Mr. Bidwell stated that when placed at a distance of 16 feet from a small window (the day being overcast, and all other windows closed), the light from this window had an effect upon a sulphide of silver cell represented by the movement of the spot of light of a mirror galvanometer through 90 scale divisions. By the substitution of a delicate thermopile for the sensitive cell, it was found that the heat radiation in this case was equal to that from a human body at a distance of 10 ft. 6 in. A nearly red-hot glass ball, held within an inch of the cell, produced a fall of resistance only equal to 23 scale divisions in 15 seconds, while, of course, the effect produced by the human body at the distance named was absolutely *nil*. It appears, therefore, that Mr. Bidwell has a means of observing light radiations not liable to be vitiated by ordinary temperature conditions.

INTELLIGENCE OF THE DOG.

BEFORE a crowded sitting of the Biological Section of the British Association, Sir John Lubbock read a paper in which he gave some interesting notes on the intelligence of the dog. The man and the dog, he said, have lived together in more or less intimate association for many many thousands of years, and yet it must be confessed that they know comparatively little of one another. That the dog is a loyal, true, and affectionate friend must be gratefully admitted; but when we come to consider the psychical nature of the animal, the limits of our knowledge are almost immediately reached. I have elsewhere suggested that this arises very much from the fact that hitherto we have tried to teach animals rather than to learn from them—to convey our ideas to them rather than to devise any language or code of signals by means of which they might communicate theirs to us. The former may be more important from a utilitarian point of view, though even this is questionable, but psychologically it is far less interesting. Under these circumstances, it occurred to me whether some such system as that followed with deaf mutes, and especially by Dr. Howe with Laura Bridgman, might not prove very instructive if adapted to the case of dogs.

I have tried this in a small way with a black poodle named Van. I took two pieces of cardboard about 10 in. by 3 in., and on one of them printed in large letters the word "food," leaving the other blank. I then placed two cards over two saucers, and in the one under the "food" card put a little bread and milk, which Van, after having his attention called to the card, was allowed to eat. This was repeated over and over again till he had had enough. In about ten days he began to distinguish between the two cards. I then put them on the floor and made him bring them to me, which he did readily enough. When he brought the plain card I simply threw it back, while, when he brought the "food" card, I gave him a piece of bread, and in about a month he had pretty well learned to realize the difference. I then had some other cards printed with the words "out," "tea," "bone," water," spelt phonetically so as not to trouble him by our intricate spelling, and a certain number also with words to which I did not intend him to attach any significance, such as "nought," "plain," "ball," etc.

Van soon learnt that bringing a card was a request, and soon learned to distinguish between the plain and the printed cards; it took him longer to realize the difference between words, but he gradually got to recognize several, such as food, out, bone, tea, etc. If he was asked whether he would like to go out for a walk, he would joyfully fish up the "out" card, choosing it from several others, and bring it to me, or run with it in evident triumph to the door.

I need hardly say that the cards were not always put in the same places. They were varied quite indiscriminately and in a great variety of positions. Nor could the dog recognize them by scent. They were all alike, and all continually handled by us. Still, I did not trust to that alone, but had a number printed for each word. When, for instance, he brought a card with "food" on it, we did not put down the same identical card, but another bearing the same word; when he had brought that, a third, then a fourth, and so on. For a single meal, therefore, eighteen or twenty cards would be used, so that he evidently is not guided by scent. No one who has seen him look down a row of cards and pick up the one he wanted could, I think, doubt that in bringing a card he feels he is making a request, and that he can not only distinguish one card from another, but also associate the word and the object. This is, of course, only a beginning, but it is, I venture to think, suggestive, and might be carried further, though the limited wants and aspirations of the animals constitute a great difficulty. My wife has a very beautiful and charming collie, Patience, to which we are much attached. This dog was often in the room when Van brought the "food" card and was rewarded with a piece of bread. She must have seen this thousands of times, and she begged in the usual manner, but never once did it occur to her to bring a card. She did not touch or indeed even take the slightest notice of them. I then tried the following experiment: I prepared six cards about 10 in. by 3 in., and colored in pairs—two yellow, two blue, and two orange. I put three of them on the floor, and then, holding up one of the others, endeavored to teach Van to bring me the duplicate. That is to say, that if the blue was held up, he should fetch the corresponding color from the floor; if yellow, he should fetch the yellow, and so on. When he brought the wrong card, he was made to drop it, and return for another till he brought the right one, when he was rewarded with a little food. The lessons were generally given by my assistant, Miss Wendland, and lasted half an hour, during which time he brought the right card on an average about twenty-five times. I certainly thought that he would soon have grasped what was expected of him. But no. We continued the lessons for nearly three months, but, as a few days were missed, we may say ten weeks, and yet at the end of the time I cannot say that Van appeared to have the least idea what was expected of him. It seemed a matter of pure accident which card he brought. There is, I believe, no reason to doubt that dogs can distinguish colors; but as it was just possible that Van might be color blind, we then repeated the same experiment, only substituting for the colored cards others marked respectively I., II., and III. This we continued for another three months, or, say, allowing for intermission, ten weeks, but to my surprise entirely without success.

I was rather disappointed at this, as, if it had succeeded, the plan would have opened out many interesting lines of inquiry. Still, in such a case, one ought not to wish for one result more than another, as of course the object of all such experiments is merely to elicit the truth, and our result in the present case, though negative, is very interesting. I do not, however, regard it as by any means conclusive, and should be glad to see it repeated. If the result proved to be the same, it would certainly imply very little power of combining even extremely simple ideas. I then endeavored to get some insight into the arithmetical condition of the dog's mind.

On this subject I have been able to find but little in any of the standard works on the intelligence of animals. Considering, however, the very limited powers of savage men in this respect—that no Australian language, for instance, contains numerals even up to four, no Australian being able to count his own fingers even on one hand—we cannot be surprised if other animals have made but little progress. Still, it is surprising that so little attention should have been directed to this subject. Leroy, who, though he expresses the opinion that "the nature of the soul of animals is unimportant," was an excellent observer, mentions a case in which a man was anxious to shoot a crow. "To deceive this suspicious bird, the plan was hit upon of sending two men to the watch-house, one of whom passed on, while the other remained; but the crow counted, and kept her distance. The next day three went, and again she perceived that only two retired. In fine, it was found necessary to send five or six men to the watch-house to put her out in her calculation. The crow, thinking that this number of men had passed by, lost no time in returning." From this he inferred that crows could count up to four. Lichtenberg mentions a nightingale which was said to count up to three. Every day he gave it three mealworms, one at a time; when it had finished one, it returned for another, but after the third it knew that the feast was over. I do not find that any of the recent works on the intelligence of animals, either Buchner, or Peitz, or Romanes, in either of his books, give any additional evidence on this part of the subject. There are, however, various scattered notices.

There is an amusing and suggestive remark in Mr. Galton's interesting "Narrative of an Explorer in Tropical South Africa." After describing the Damara's weakness in calculations, he says: "Once while I watched a Damara floundering hopelessly in a calculation on one side of me, I observed Dinah, my spaniel, equally embarrassed on the other; she was overlooking half a dozen of her new-born puppies, which had been removed two or three times from her, and her anxiety was excessive, as she tried to find out if they were all present or if any were still missing. She kept puzzling and running her eyes over them backward and forward, but could not satisfy herself. She evidently had a vague notion of counting, but the figure was too large for her brain. Taking the two as they stood, dog and Damara, the comparison reflected no great honor on the man." But even if Dinah had been clear on this subject, it might be said that she knew each puppy personally, as collies are said to know sheep.

The same remark applies generally to animals and their young. Swans, for instance, are said to know directly if one of their cygnets is missing, but it is probable that they know each young bird individually. This explanation applies with less force to the case of eggs. According to my bird nesting recollections, which I have refreshed by more recent experience, if a nest contains four eggs, one may safely be taken; but if two are removed, the bird generally deserts. Here then it would seem as if we had some reason for supposing that there is sufficient intelligence to distinguish three from four.

An interesting consideration rises with reference to the number of the victims allotted to each cell by the solitary wasps. Ammophile considers one large caterpillar of Noctura segetum enough; one species of Eumenes supplies its young with 5 victims; another 10, 15, and even up to 24. The numbers appear to be constant in each species.

How does the insect know when her task is fulfilled? Not by the cell being filled, for if some be removed she does not replace them. When she has brought her complement, she considers her task accomplished, whether the victims are still there or not. How, then, does she know when she has made up the number 24? Perhaps it will be said that each species feels some mysterious or innate tendency to provide a certain number of victims. This would under no circumstances be any explanation, but it is not in accordance with the facts. In the genus Eumenes the males are much smaller than the females. Now, in the hive bees, humble bees, wasps, and other insects where such a difference occurs, but where the young are directly fed, it is of course obvious that the quantity can be proportioned to the appetite of the grub. But in insects with the habits of Eumenes and Ammophila the case is different, because the food is stored up once for all. Now, it is evident that if a female grub was supplied with only food enough for a male, she would starve to death; while if a male grub were given enough for a female, it would have too much. No such waste, however, occurs. In some mysterious manner the mother knows whether the egg will produce a male or female grub, and apportions the quantity of food accordingly. She does not change the species or size of her prey; but if the egg is male, she supplies 5, if female 10, victims. Does she count? Certainly this seems very like a commencement of arithmetic. At the same time it would be very desirable to have additional evidence how far the number is really constant. Considering how much has been written on instinct, it seems surprising that so little attention has been directed to this part of the subject. One would fancy that there ought to be no great difficulty in determining how far an animal could count; and whether, for instance, it could realize some very simple sum, such as that two and two make four. But when we come to consider how this is to be done, the problem ceases to appear so simple. We tried our dogs by putting a piece of bread before them, and prevented them from touching it until we had counted seven.

To prevent ourselves from unintentionally giving any indication, we used a metronome (the instrument used for giving time when practicing the pianoforte), and to make the beats more evident we attached a slender rod to the pendulum. It certainly seemed as if our dogs knew when the moment of permission had arrived; but their movement of taking the bread was scarcely so definite as to place the matter beyond a doubt. Moreover, dogs are so very quick in seizing any indication given them, even unintentionally, that, on the whole, the attempt was not satisfactory to my mind. I was the more discouraged from continuing the experiment in this manner by an account Mr. Huggins gave me of a very intelligent dog belonging to him. A number of cards were placed on the ground, numbered respectively 1, 2, 3, and so on up to 10. A question is then asked; the square root of 9 or 16, or such a sum as $6 \times 52 - 3$. Mr. Huggins pointed consecutively to the cards, and the dog barked when he came to the right one. Now, Mr. Huggins did not consciously give the dog any sign, yet so quick was the dog in seizing the slightest indication that he was able to give the correct answer. This observation seems to me of great interest in connection with the so-called "thought reading." No one, I suppose, will imagine that there was in this case any "thought reading" in the sense in which this word is used by Mr. Bishop and others. Evidently Kepler seized upon the slight indications unintentionally given by Mr. Huggins. The observation, however, shows the great difficulty of the subject. I have ventured to bring this question before the section, partly because I shall be so much obliged if any lady or gentleman present will favor me with any suggestions, and partly in hope of inducing others with more leisure and opportunity to carry on similar observations, which I cannot but think must lead to interesting results.

THE BED OF THE OCEAN.

THE Tuesday evening discourse during the meeting of the British Association was delivered by Mr. J. Murray, F.R.S., of the Challenger expedition, who took for its subject the "Bed of the Ocean, and Some Results of the Expedition."

In commencing his lecture, Mr. Murray traced the development of geographical knowledge from the crude conception of the ancients down to the extended knowledge of the nineteenth century. It was not easy, he said, to estimate the relative importance of the events of one's own time, yet, in all probability, the historians of the reign of Victoria would point to the recent discoveries in the great oceans as the most important events of the century with respect to the acquisition of natural knowledge—as among the most brilliant conquests of man in his struggle with nature; and doubtless they would be able to trace the effects of these discoveries on the literature and on the philosophic conceptions of our age. The last of the great outlines showing the surface features of our globe had been boldly sketched; the foundations of a more complete and scientific physiography of the earth's surface had been firmly laid down. The lecturer then briefly described the chief surface features of the globe, the action of wind and water and ocean currents; referred to the temperature of the surface of the sea, and explained that the most important as well as the most direct effect of the unequal distribution of temperature over the surfaces of the oceans and continents was an unequal distribution of atmospheric pressure, varying more or less with season. He then proceeded: The advances during recent years in the knowledge of one form of life inhabiting the floor of the ocean surpassed those in any other department of oceanic investigation. Thousands of new organisms have been discovered in all seas and at all depths in the ocean, and either had been or were now being described by specialists in all quarters of the world. There did not seem to be any part of the ocean bed so deep, so dark, so still, or where the pressure was so great as to have effectually raised a barrier to the invasion of life in some of its many forms. Even in the greater depths all the great divisions of the animal kingdom were represented. As they descended into the deeper waters, and proceeded further seaward from the borders of the continents, species and the number of individuals became fewer and fewer, though they often presented archaic or embryonic characters, till a minimum was reached in the greatest depths farthest from continental land. Distance from continental land was indeed a much more important factor in the distribution of deep-sea animals than actual depth. If they neglected the Protozoa, and compared the results of twelve of the Challenger's trawlings and dredgings in the central line of the Pacific, in depths greater than 2,000 fathoms, on globigerina ooze, radiolarian ooze, and red clay, with twelve trawlings and dredgings taken under similar conditions and depths, but on the blue and green muds within 200 miles of the continents, they found that the Central Pacific stations yielded 92 specimens of animals belonging to 52 species, all—with two doubtful exceptions—new to science, and among them 13 new genera. On the other hand, the stations near the continents gave over 1,000 specimens, belonging to 211 species, of which 145 were new species and 66 belonged to species previously known from shallower water.

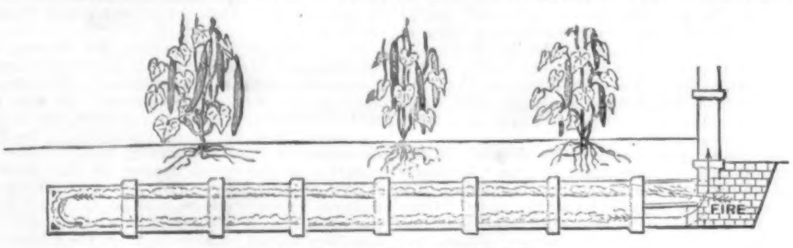
Although no new types of structure had been discovered in organisms from the deep sea, the peculiar modifications which animals had undergone to accommodate themselves to abysmal conditions were sufficiently interesting and remarkable. The eyes of some fish and crustaceans had become atrophied or had disappeared altogether, while in others they had become of exceedingly large size, or been so modified as to be scarcely recognizable as eyes. Fins and antennæ had become extraordinarily elongated, and at times appeared to simulate the alcyonarians of the deep sea.

The higher crustacea and some families of fish had very few and very large eggs in the deep-sea species, while their shallow water representatives had a very large number of very small eggs, showing apparently that the deep-sea species had relatively few enemies. Many deep-sea animals emitted, and some had special organs for the emission of phosphorescent light, which appeared to play a large *role* in the economy of deep-sea life. One of the most striking facts with respect to deep-sea animals was their very wide distribution, the same species being found in all the great ocean basins. After referring to examinations of coral atolls and barren reefs, Mr. Murray said the results of many lines of investigation seemed to show that in the abysmal regions they had the most permanent areas of the earth's surface, and he was a bold man who still argued that in Tertiary times there was a large area of continental land in the Pacific, that there was once a Lemuria in the Indian Ocean, or a continental Atlantis in the Atlantic. It mattered little whether the opinions which he had given as to the bearing of some of the researches be correct or not. The great point was that there had been a vast addition to human knowledge, and it must be a matter of satisfaction that our own country had taken so large a share in these important investigations as to call forth the admiration of scientific men of all countries. In the matter of deep-sea investigation, neglecting mere details, we could say that successive Governments during the past twenty years had, either from design or by accident, undertaken a work in the highest interests of the race, had carried it on in no mean or narrow spirit, and were likely to carry it to a termination in a manner worthy of a great, free, and prosperous people.

AN UNDERGROUND FLUE.

THE accompanying sketch needs but little description. The whole success of the plan rests on the well-known facility with which atmospheric layers run over and under each other; the hot current naturally runs along the top side, and the cool return current along the bottom. It seems, however, very odd to place the outlet below the inlet, yet this is right, and the cooler air and smoke then go up the chimney. There is no tendency for the hot air to make a short cut downward and get straight into the chimney. It runs right to the end, which in the flue I have made is 20 feet from the fire, and heats it nearly if not quite equally all the way. The large pipes are 12-inch bore, and act perfectly; the whole affair is laid dead level, and the chimney, of 6-inch pipes, is about 8 feet high.

As to fuel, is burns any rubbish in the simple brick hole which acts as fire-place, and which has to be covered with an iron plate so tilted as to let air in where it is most advantageous. By any rubbish I mean all kinds of garden waste—dried cabbage stems, sweepings of woodsheds, old wood waste, dry weeds, and all the matter of which so much comes from a garden in the successive seasons. It will not burn coke, coal, or heavy fuel. Observe that the flue entrance is kept free, and there is always a draught. Light up for two or three hours on alternate days, and your bed of soil is kept very pleasantly warm at a cost of nothing but the trouble of doing it.—*A. Dawson, The Garden.*



AN UNDERGROUND FLUE.

PRODUCTION OF DOUBLE FLOWERS.

IT is possible that most of our decorative plants which produce double flowers, such as the rose and the camellia, may have originally been single. We know that the dahlia when first introduced to this country was single. As regards the dahlia, indeed, single-flowered varieties have of late been even more popular than double-flowered sorts. But that does not detract from the merit due to the florist or cross-breeder who has brought such flowers as the double dahlia, the rose, the camellia, and the ranunculus, etc., to the degree of perfection which they have attained; yet, strange as it may appear, there is no method or course of treatment known to us by which single-flowered plants can be induced to produce double blooms. How, then, it may be asked, have double flowers been produced? Before endeavoring to answer this question, it may be necessary to say that there are at least two kinds of double flowers, each very distinct from the other. The doubling of the flowers of such plants as the dahlia, as well as those of all composite plants, is caused by disk florets becoming ray florets, each being a distinct and perfect bloom. Therefore such flowers as the so-called double dahlia and double sunflower, etc., may be regarded more as accumulations of single blooms than as double flowers, and they differ materially from flowers of other species of plants, which become double by the changing of stamens into petals. Therefore plants whose flowers have the greatest number of stamens are the most likely to become double. I may mention that the single snowdrop will frequently become double when transplanted into rich ground, and I have also known the same thing to occur when it has been transplanted into very poor, light soil. However, as regards the generality of flowering plants, I believe that nothing in the way of high culture, or the use of stimulating soils, has ever been known to have the effect of inducing plants to produce double flowers. Many may be inclined to say that double flowers are no improvement upon single ones, and in many instances that may be admitted to be the case, but at the same time the preference for single or for double flowers may be set down as a matter of taste or opinion. Few will be found to object to the doubling of the rose, the camellia, and the ranunculus, etc., and even in the case of the zonal pelargonium it will be admitted that many very beautiful as well as useful varieties of double-flowered sorts have been secured. They are useful, inasmuch as they remain longer in good condition after being cut than single-flowered varieties do. Only a few years ago double-flowered pelargoniums, petunias, cinerarias, and tuberous begonias were unknown; they are all now common enough, and they have all, I believe, been obtained by carefully fertilizing such blooms as show a tendency to become double with their own pollen, or, what is better, with pollen from another plant of the same species which may have been found to show a similar disposition toward duplicity. When fertilization is effectually performed, it is generally found that the doubling is more pronounced or intensified in a portion, at least, of the progeny. It is true that when flowers become perfectly double they can seldom be induced to produce seed, but at the same time it seldom happens that blooms are produced so double that a few stamens may not be found among the petals, and the pollen of these, if applied to semi-double blooms in which the stigma and ovary are in their normal condition, will mostly be found to furnish a considerable percentage of plants with flowers more or less double.—*P. Grieve, The Garden.*

[NATURE.]

FORMATION OF SNOW CRYSTALS FROM FOG.

IN addition to the actual fall of snow, hail, etc., there is on Ben Nevis a form of solid precipitation scarcely known on lower ground, but of almost daily occurrence here. In ordinary weather the top of the hill is enveloped in drifting fog, and when the temperature of the air and ground is below freezing, this fog deposits small crystalline particles of ice on every surface that obstructs its passage. These particles on a wall or large sloping surface, so well described in a recent letter in *Nature*, combine to form long feathery crystals; but on a post or similar small body they take a shape more like fir-cones, with the point to the windward. Whether this disposition is from the vapor of the fog directly or from actual particles of frozen water carried along in it is not very clear. The forms and arrangements of the crystals vary according to the form of the surface to which they adhere, but all belong to this feathery or cone type, the branches lying at an angle of 30° with the main axis pointing to windward. They are formed wherever the wind blows past an obstructing body. On a flat board they gather first and most abundantly near its edges, forming a most beautiful border around it; while the center, which I suppose the wind does not directly reach, remains clear. A round post, on the contrary, has an almost uniform crop of these crystals all over its windward half, and so accurately do they point to windward that it is possible to trace changes in the direction of the wind from the successive layers of crystals lying at different angles. The rate of growth varies with the density of the fog and the speed of the wind, but for the ordinary winds and fogs of this exposed position about half an inch per hour may be taken as a rough average. I have never seen it exceed two inches per hour. If there is a damp feeling in the air, if in fact it is mist that is passing rather than fog, the crystals are icy and hard; but when the temperature is well below freezing, and the fog feels comparatively dry, they are looser in texture, seem when first formed to be attached by a mere point to whatever they are on, and are pretty easily knocked off. There is practically no limit to their growth; last winter, during a long continuance of strong south-westerly winds and cold weather, a post 4 inches square grew into a slab of snow some 5 ft. broad and 1 foot thick in less than a week; the crystalline mass then fell off by its own weight, and a new set began to form.

The effect of this growth on all the instruments exposed to its action may be easily imagined. Nothing keeps its shape or color. The louvres of the Stevenson's screen for the thermometers become serrated with rows of teeth which quickly coalesce into a solid mass, completely stopping any circulation of air inside the box. The use of exposed radiation thermometers, black bulb *in vacuo*, etc., is rendered well nigh impossible, as these delicate glass instruments would run serious risk of breakage in clearing them of the deposit, while their readings would have little value, being merely the record of the temperature inside a more or less opaque mass of snow. Very often the rain-gauge is coated with these crystals an inch thick on its windward side, while not a particle is to be seen inside. Ordinary anemometers of the type of Dr. Robinson's cup instrument become useless; the cups are no longer hemispheres, but irregular hollow bodies bristling all over with pointed crystals, and the arms carrying them increase to many times their original thickness, thus offering much greater surface for the wind to act on. Under such circumstances the anemometer at the Observatory is usually left to its own devices, and grows into an irregular mass of snow scarcely showing any trace of its original outline, to be cleared again when dry weather or a thaw gives it a chance of working. When the fog comes on while the anemometer is still turning, the crystals form chiefly on the outside of the cups and around their edges, leaving the insides pretty clear. The arms carrying the cups get completely covered, and on the diagonal stays supporting the arms the crystals show a beautiful "twined" structure pointing downward and outward on each side.

Occasionally the crystals are smoky-brown in color instead of white. For example, those found on December 23, 1884, were distinctly brown, but on the 24th these were overlain by a pure white set. What causes this change of color, and whether it is connected with any special state of the weather, I have not yet determined.

Note.—Since the above was written, I have made a rough attempt to measure definitely the rate of growth of these crystals. A cylindrical stoneware bottle of 3·6 inches high and 2·25 inches diameter was stuck upside down on a post 40 inches high for three hours at a time, the crystals formed on it melted down, and the volume of the water measured. Assuming that the cylinder acted like a flat surface placed perpendicularly to the wind, whose height and breadth are equal to its height and diameter—an assumption that appears to be very nearly true, at least for small surfaces—I find that with dense fog and strong wind (force 6 to 8 of Beaufort's scale) the rate of growth, as measured above, is about 0·125 inch per hour. That is to say, if the density of the snow be one-tenth that of the water, the crystals were growing at the rate of one and a quarter inches per hour. The crystals were quite loose and feathery, and contained practically no fallen or drifted snow; all had been formed directly out of the fog. R. T. OMOND.

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